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Telephony.

AN ILLUSTRATED MONTHLY TELEPHONE JOURNAL

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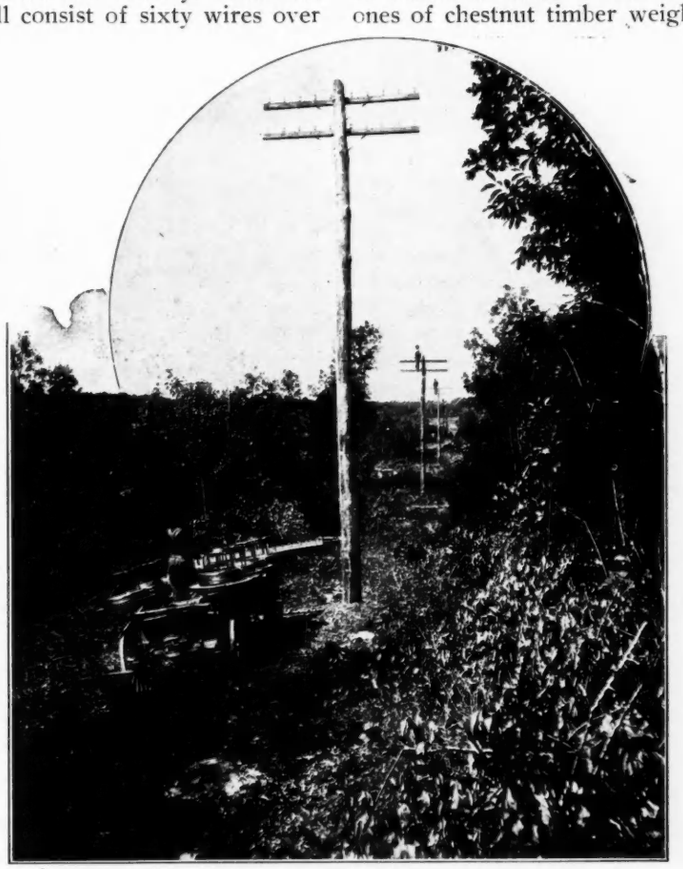
How a Telephone Line Is Built

BUILDING of telephone lines under adverse circumstances is not confined to the remote parts of the far west. There is at present in Connecticut a telephone construction party engaged in work amidst conditions not so unlike those of the most rugged western country. The line, which is on a direct route, will consist of sixty wires over which both telegrams and speech may travel. The portion of the line now building runs through a rough, wooded region, cut up by streams and ravines and well calculated to tax the ingenuity and brawn of the construction crew. Densely populated as Connecticut apparently is, its people are for the most part gathered into cities and large towns, and this rocky country through which the party is operating is so sparsely settled that it contains few houses. The men live under canvas, following the line and moving forward about every three weeks.

As soon as the wires have been stretched to a point three or four miles beyond camp, "moving day" arrives. Then the fifty or more men turn to, "rip up camp" and in less than an hour the dozen wagons hired for the occasion are on the road to the next stamping ground, which is usually five or six miles beyond the last "tie" and located, as all good camps should be, with an eye to drainage, wood and water.



LINEMEN AT WORK WITH REEL WAGON.

In the construction of a telephone line of this magnitude the first step is the selection of the route. Maps of the country to be traversed are carefully studied, but maps alone are not enough. The engineers must have explicit information regarding every twist and turn of a road or stream. The line is at the outset roughly dotted on the maps, but the route thus suggested is apt to be changed many times, as the engineers make their own topographical plots of the territory and study its characteristics. It is desirable, if possible, to get suitable poles from the surrounding country and, other things being equal, the route will be arranged to facilitate the handling of poles made from native timber. In the construction of this line the poles, exceptionally fine ones of chestnut timber weighing about two tons each, are obtained from the neighborhood through which the wires run.

After the line has been roughly sketched on the map, the chief of construction with his engineers and other assistants drive and walk over the routes for some distance. Then the engineers get down to hard work and make the final locations. First they have to decide on the places where the poles will be put in at intervals of 130 feet and mark these with stakes of the kind familiar in all surveying work and bearing distance, numbers and notations concerning the "anchors" and "guys" which are to be used at the angles in the line.

To guide the construction crew the engineers prepare very exact specifications, which are based upon the results of years of experience and experiment and take into account such factors of safety that the strength of the completed work is assured. Any departure from the specifications, which, as the construction chief says, are "ironclad and sufficient," may be justified only by some unforeseen exigency.

All the while that the necessary permissions and rights of way are being procured the "timber men" are getting out the poles and seeing that they are placed by the stakes. Naturally all the sticks of timber on which the wires are to be strung are not of the same length. A "thirty-five-foot line," such as the one now constructing, gives a minimum

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of that length to the poles, but in depressions sixty, seventy or 100 foot poles are sometimes needed.

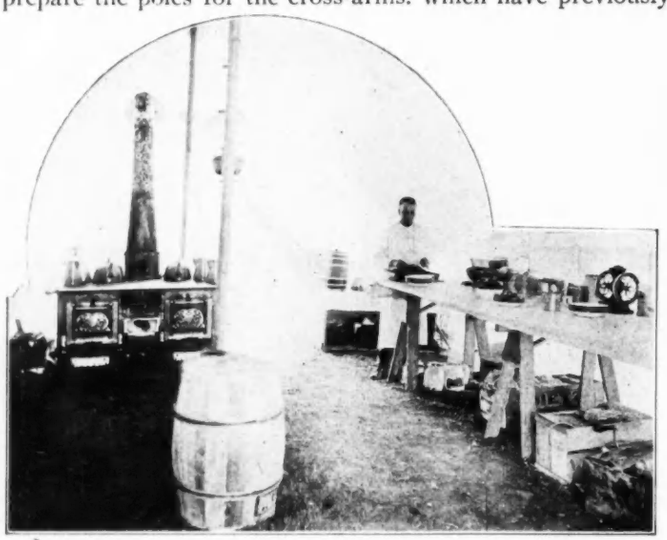
Just as soon as sufficient timber has been prepared the gang is organized. Foremen are appointed and these choose their subordinates, striving, of course, to secure veterans in the business, though in the case of the line referred to above it happened that old hands were few, because of other lines under simultaneous construction in various sections of the

BOSSES' TENT IN CONSTRUCTION CREW'S CAMP.

country. Organizing here, therefore, included the drilling of a great many men hitherto unaccustomed to the work.

As a first step the "trimmers" are started out to clear the route, cutting away all brush and trees which might interfere with the construction. Then follow the "diggers," whose duty it is to prepare the holes in the rocky Connecticut soil. Often they are obliged to use small charges of dynamite in excavating. It is employed in the safest way possible by using forty per cent nitroglycerin and electric batteries to discharge the caps, together with a very long firing wire which enables the men to get far out of danger.

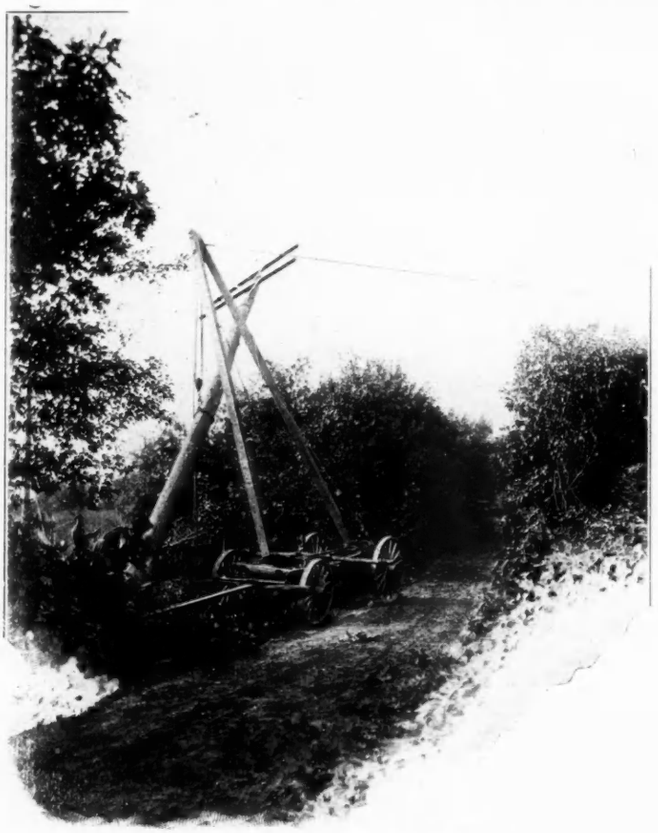
Along with the "diggers" are found the "gainers," who prepare the poles for the cross-arms. which have previously



CAMP COOK PREPARING A MEAL.

been placed beside each pole by two men whose base of supplies is a two or four horse team. Then come the "pole setters," who in an ordinary party number from twenty to thirty. Next after these are six or seven men engaged in "filling"—that is, in straightening the poles and filling up the holes. Then the "wire stringers," who keep always close up to the "fillers" and put the wire in place, leaving behind a line that is complete as far as the wires go. Finally the "bankers" bring up the rear, banking the dirt about the bases of the poles. These last are expected also to bring along any tools which have been left behind by the others. Of course all the most modern appliances are used in building this new line. There are, in fact, some novel features in the equipment. Chief of these are the "pole derrick" and the "wire wagon."

Of the former device there are said to be only a few in existence. It is a simple contrivance, consisting of a heavy wagon with two twenty-eight-foot spars standing like an inverted V, with one leg over each pair of wheels. After the derrick has been dragged to a pole hole the derrick is guyed by four men to adjacent trees or rocks so that a two or three ton pole may be lifted without overturning it. After the machine stands ready for action the pole cross-arms are screwed on and their supports spiked. Around



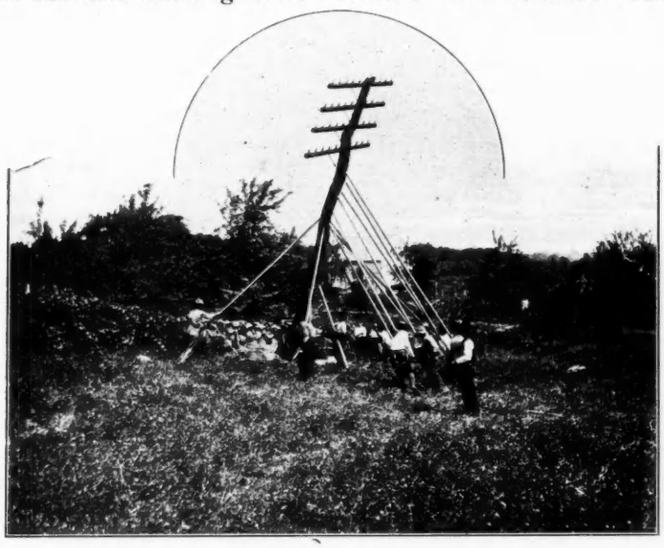
NEW DERRICK IN ACTION.

the pole a strong logging chain is passed well above the center of gravity and the horses are hitched to the draw rope. With a "Let her go!" from the foreman, the horses start on a steady, even pull, the ropes tighten, the blocks creak and in a moment the great spar swings clear of the ground. Two of the men guide its butt and as soon as it is over the hole the horses back slowly and it sinks into place. The foreman then climbs up the shaft and removes the chain, the horses are hitched up again and the derrick moves on to the next pole. After that the "fillers" straighten up the pole just set and fill in the earth about it.

This way of handling poles is in striking contrast to the ordinary method, in which from twenty to thirty men pick the pole up and with great difficulty put it in place with "pikepoles." The derrick requires four men, two horses and a boy to drive them. The cost difference per day runs from $15 to $20 in favor of the derrick.

The "wire wagon," which effects a simultaneous "stringing" of ten wires at once, is an even greater improvement

than the derrick. It consists essentially of a very heavy, specially constructed wagon with five wire reels placed horizontally on either side. There is a long bar of wood with ten catches on it for the wires to pass through at the back of the wagon bed. It serves to keep the wires separate and to facilitate handling them. When a "run" is made—that



POLE RAISING WITH PIKES.

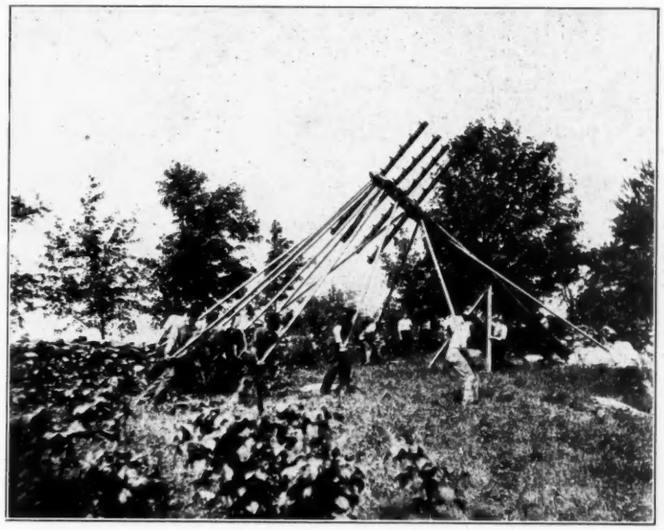
is, when a section of wires is to be strung—the ends of the wires are first passed through the catches and then hooked upon the "board," a piece of steel about two feet wide, to which a long rope is attached. This rope is passed over the cross-arms of the first two or three poles by climbers and the wagon team is hitched to it. When all is ready the horses start along the line and the wires begin to pull. The rope passing over the pole arm draws the "board" up to the

VIEW OF CONSTRUCTION CAMP.

man on the cross-arm. He in turn throws it over, separating the wires as soon as it passes by.

As soon as the wires have been placed inside the insulators he hurries down the pole and climbs a third or fourth one further on. While he is hurrying to get into position the "board" has passed over another pole and another section of the line is in place. This performance is repeated until the "board" meets the end of the wires already strung. Then one by one they are connected. The wires are joined together by putting the ends into a "double sleeve" of copper and then twisting them to make a joint.

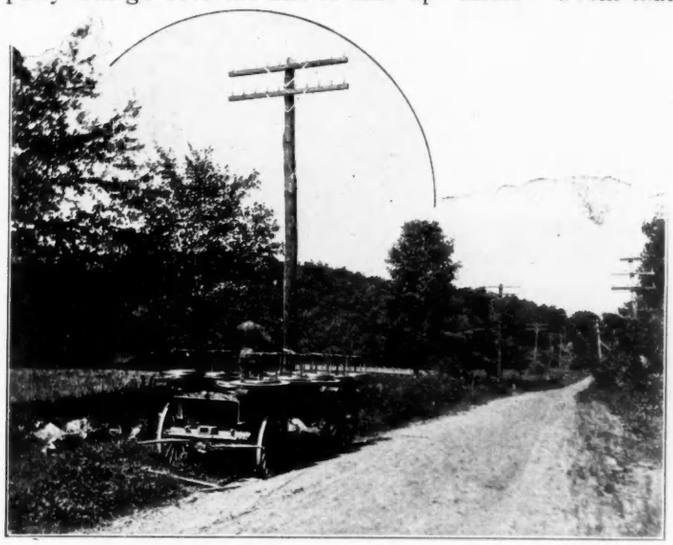
After a "run" has been made and half a mile or so of wire has been looped over the cross-arms the stretching and the "tying on" begin. Starting from the connections with the last fully stretched sections, each wire is taken separately and stretched to the requisite tightness and then "tied" to the insulators. This is done with the assistance of "come-alongs" and pulleys. The "come-along," it should be explained, is a small contrivance for holding the wire with a grip which cannot slacken or slip. As there is a pulley attached to it, the lineman can get as much pull as he needs on the wire. Usually a span of about five poles is stretched at one time. When the wire reaches the requisite tautness



OLD METHOD OF POLE-RAISING.

the man handling the "come-along" throws up his hands, shouting "tie" to the men on the other poles, and the wire is permanently fastened to the insulators.

Of course the hard-drawn copper wire which is the standard stretches considerably and allowance is made for a seven-inch vertical sag in the middle of the loops. Within about eight months after the line has been finished the wire will have reached its maximum "sag" and then another party will go over the line to take up "slack." From that



UNWINDING FROM REEL WAGON.

time on there may be a very little sag, but at the end of two years the wire will have practically ceased stretching and will require no further attention.

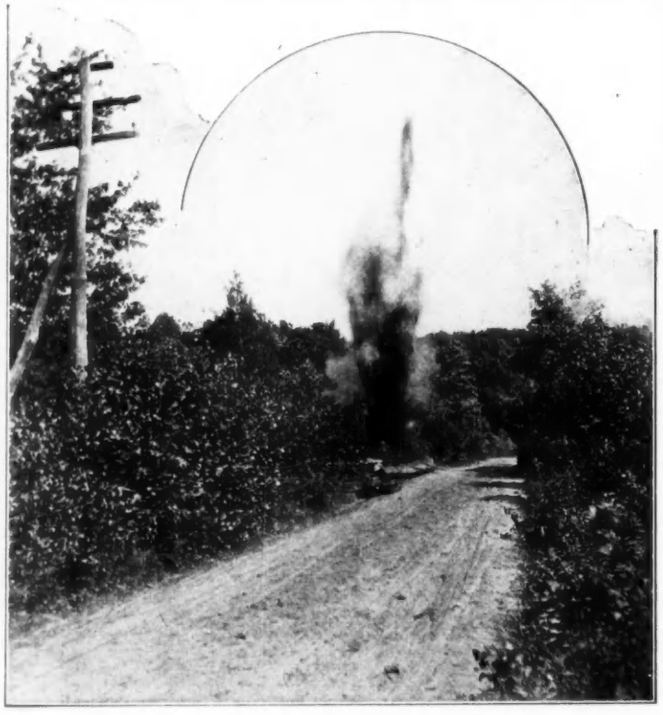
The lonesome part of the construction work falls to the lot of the "bankers." Sometimes two or more of these men

work together, but on this particular job one man has been doing it all. When the line was seven miles out of Rockville, Connecticut, the lone banker started in and caught up with the party in so short a time that there was some doubt regarding the quality of his workmanship. Inspection, however, showed that he had done his work not only rapidly, but excellently, and as a result his wages were raised.

POLE SETTING GANG AT WORK.

All these men are paid by the month and their wages run high for this class of employment.

The day in a telephone camp begins at 5:30 a. m. and ends at about 6 p. m. The men breakfast at 6 and start in on their work as soon thereafter as possible. The midday



DIGGING POLE HOLES WITH DYNAMITE.

meal is brought out to them by wagon and usually eaten in the shade near a spring or brook. By 6 o'clock in the evening the men come tramping back into camp, tired and hungry. After the grime of the day's toil has been removed they gather in the great dining tent where the cook does not dare on his life to keep them waiting long. He comes to the door of the adjoining "cook tent," beats on a tin pan and the men know that a supper of the best food that can be procured is ready. After eating heartily the men smoke their pipes and sit about talking or repairing their kits until 9 o'clock. By 9:30 the tents are dark, with the possible exception of the cook's department and the superintendent's, for the chief and his clerk may have to sit up a little later writing out the details of the day's work and the chef and his assistants are still washing dishes and making preparations for breakfast. Before long even these turn in and the camp is shrouded in darkness. The men sleep on canvas cots under as many blankets as are needed in the chilly night air of the Connecticut woods.

The superintendent and clerk divide the responsibility of camp and construction, the "super" looking after all work done and the clerk keeping account of all material used, of the men's pay, the commissary and the general maintenance of the party. For the accommodation of the camp he carries a small stock of tobacco and wearing apparel, and if the men do not care to pay cash, he charges the cost of articles received against their salary accounts. He also supervises the movings which take place every three weeks and selects the new camping places.

PASTOR USES PULPIT TELEPHONES.

The Rev. Royal Wilkins Raymond, pastor of the Stratford Methodist Episcopal church of Bridgeport, Connecticut, and his parishioners are greatly pleased by a system of telephony installed in the church whereby the tones of the pastor's voice are carried to deaf members of his congregation. Although the idea is still in the nature of an experiment, there is little doubt that the telephones will be permanently placed in the pews of any of the congregation who are now unable to hear the sermons or to follow the service.

"For some time," said the pastor, "I have noticed that certain members of my congregation had difficulty in following the service, owing to their inability to hear distinctly. I tried changing my tones, altering the pitch and using various other vocal methods, but it proved difficult and a strain upon my voice. I saw the little office telephones which are in many buildings, and knowing that persons who are ordinarily quite deaf can frequently hear by the aid of telephones, I decided to try them in my church. The receiver of an ordinary office telephone was considerably enlarged and a mouthpiece like a megaphone was placed in front of it. From that wires were run to receivers in four of the pews. Two of the receivers had the head attachments and two had handles, an arrangement making them somewhat resemble a lorgnette.

"The plan has been tried at only one service, and so, of course, it cannot be told exactly how it will succeed. I was pleased to notice that one of my parishioners who generally has difficulty in hearing, when aided by an ear trumpet easily followed the service with the help of the telephone. As the arrangement is not a toy, but is designed to help afflicted persons in joining in our services, it is in nowise out of place as a part of the church furniture. In speaking I find I can use my ordinary tones, which are reproduced quite clearly in the receivers. Several of my parishioners have already asked to have the wires extended to their pews. I shall try the telephones for a few more services, and if they are satisfactory they will be made permanent."

At a recent concert in Madison Square Garden, New York, by Duss and his orchestra, a novelty was introduced in the way of an electrophone, which enabled persons in Pittsburg, as well as New York, to hear the concert. The attachment resembles an ordinary telephone with a large megaphone mouthpiece.

Concerning Telephone Switchboards

SAMUEL G. McMEEN

IN THE November issue of this magazine there was described a form of common battery multiple switchboard recently developed and now in rather wide use by the various licensee companies controlled by the Bell organization. It will be remembered that a distinctive feature of the circuits and apparatus shown and described in that article was that the line in the central office had permanently bridged upon it a relay, and that this relay, containing two windings with a battery in series between them, serves the two purposes of controlling the line lamp of its own line and the supervisory lamp of any cord inserted in a jack of that line. This relay is provided with both front and back contacts for a single armature. Another feature of the system lies in the simplicity of its cord circuits, which contain, although there are three strands in each cord, no more complicated fundamental apparatus than two condensers and two lamps.

The feature of distinctive complication in this system, however, is that there is in each jack a contact required to be closed when no plug is in the jack, and to be broken by the insertion of the plug. To complicate all the multiple jacks of the switchboard while simplifying the relay equipment of the lines and cord circuits, may or may not be of distinctive advantage in practice. For the purpose of simplifying the relay equipment while retaining a reasonable simplicity of jacks, and an entire absence of breaking contacts therein,

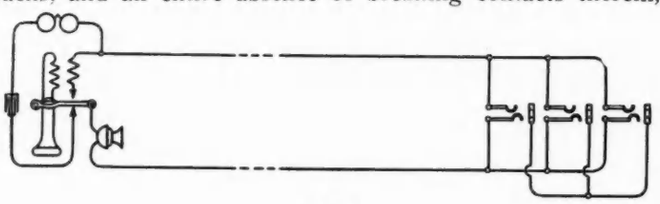


FIG. 1.

the Sterling Electric Company has devised the system of switchboard circuits illustrated in the accompanying drawings. For a clear understanding of that system, it will be of advantage to review the nature of the principles controlling the action of the line and supervisory lamps in such circuits as these.

By thinking for a moment of ordinary electric light practice, it will be seen that one incandescent lamp may be bridged across a pair of conductors having a proper voltage for the purpose, and brought to full candle power. Without affecting the brilliancy of this lamp in a noticeable degree, any number of similar lamps may be bridged across the same wires. The reason for this independent operation of the lamps, permitting one or more to be turned off or on without affecting the remainder, is that the potential of the wires on which the lamps are bridged remains practically constant without regard to the number of lamp bridges. If, however, the supply wires to these lamps are very small, or in any other way of more than a very small resistance compared to that of the lamps, a distinct change will be noticeable between the brilliancy of one lamp and the brilliancy of each of many when connected in shunt with each other.

Taking advantage of this difference in lamp brilliancy when there is a considerable resistance in the supply current, a number of ingenious arrangements have been made in the past. The first commercially successful multiple switchboard involving the use of relays and lamp signals was installed in Worcester, Massachusetts, in 1896. In this switchboard the relay was connected permanently in bridge upon the line in series with the battery, and when its armature was pulled up by the closing of the line at the subscriber's station, a line lamp was lighted at the answering jack. The cord circuit connections place a supervisory lamp of the same character as the line lamp in circuit in such a way as to place the two lamps in parallel with each other. As indicated in the foregoing, these lamps would both have been illuminated to the same brilliancy, if both had been adapted to burn on the full voltage of the battery, and either

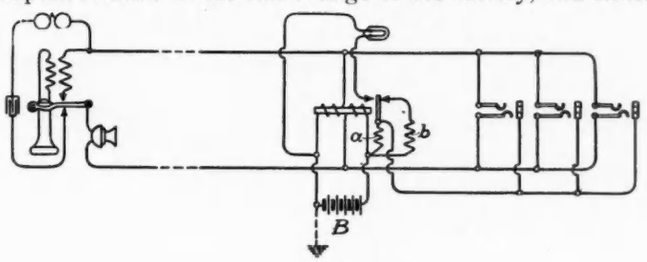


FIG. 2.

could have been connected or disconnected without affecting the other. The circuits were not so arranged, but took advantage of the usefulness of an appreciable resistance in the supply circuit. This resistance being properly proportioned the placing of the two lamps in shunt with each other, and both in series with the resistance and battery, made it possible for neither to get current enough to heat its filament to full brilliancy. In theory and in experimental work, with delicately proportioned resistances and uniform lamps, the signals operated with much success; but it is a difficult problem to proportion lamps with certainty, and a more difficult one to prevent them from changing in filament resistance; so that from these causes it has been found very difficult to prevent false showing of line lamps, and to secure an absolutely certain extinguishment of supervisory lamps during conversation.

Referring to Fig. 1, a sub-station equipment of the type

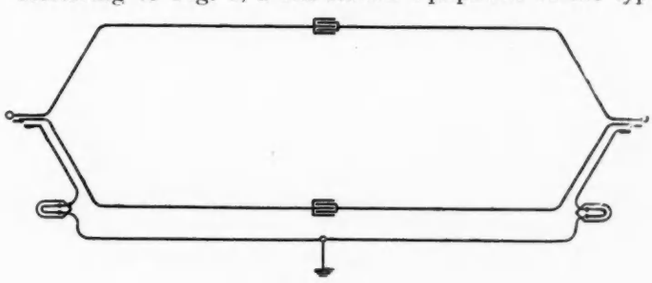


FIG. 3.

used with the form of multiple board of the Sterling Electric Company is shown associated with that part of the line circuit which composes the multiple and answering jack arrangement. It will be noted that this figure corresponds with exactness, so far as the central office portion is concerned, to the arrangement shown in Fig. 1 in the November article in this magazine concerning switchboards; but in that instance there required to be added to the jacks certain break-contact devices, whereas in this instance the jacks are complete as shown. In Fig. 2 are illustrated the line relay and battery in their bridge relation to the circuit, and it will be seen that the line lamp, when the relay closes its first contact, is lighted through the resistance *a*. In actual practice with this system the battery *B* is connected to all of the circuits in such a way that it does not depend upon a ground on

either pole for its operation of any elements of apparatus. For the sole reason that some persons find it simpler to trace circuits with reference to ground, such a connection has been indicated by dotted lines in the figures, so that where a ground is indicated, it is intended to mean that pole of the battery which is shown so grounded in Fig. 2.

In Fig. 3 it will be seen that in addition to the fact that the two talking strands of the cord circuit include each a

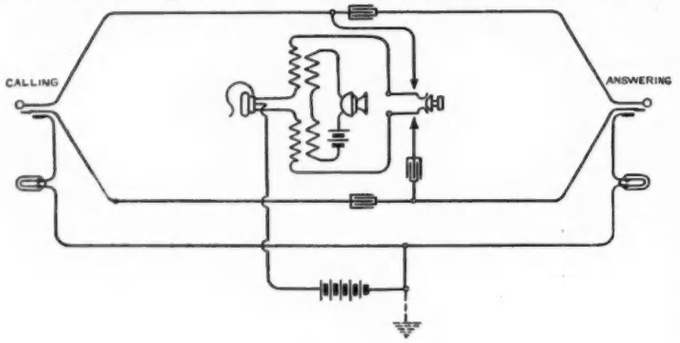


FIG. 4.

condenser, the supervisory lamp circuit is simplicity itself, the lamp being merely in series with a third strand of its cord. If, therefore, a call is instituted and a line lamp is lighted, it is evident that the line lamp circuit will remain closed during all the time of conversation, and that if the line lamp is to be extinguished it cannot be through an opening of its circuit. But when the cord circuit shown more fully in Fig. 4 is associated with the line circuit, the current carried to the relay armature through the resistance *a* will be insufficient to light the line and supervisory lamps in shunt with each other as they now are.

At the conclusion of the conversation, the relay armature will be upon its back contact, and the resistance *b* will be placed in shunt with the resistance *a*. Naturally, the line lamp will no longer be an element of the circuit, as the front contact of the relay armature is broken. Equally naturally more current will be flowing to the supervisory lamp, for two reasons First, because the line lamp is taking none, and second, because the two resistances associated with the relay are now shunting each other. The supervisory lamp potential will thus be so much increased as to insure its coming to a proper brilliancy if it is of such a voltage as to respond to that potential.

Such a condition of maximum voltage at the terminals of

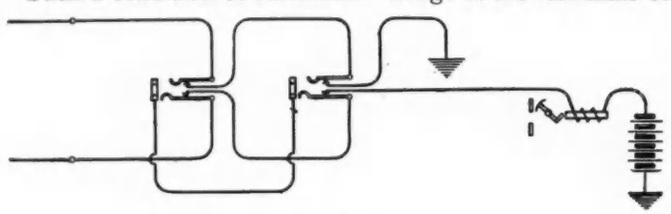


FIG. 5.

the supervisory lamp naturally exists in calling a subscriber, and before his response; and it is to be remembered that the illumination or non-illumination of the supervisory lamp is a function of two things: first, the existence or absence of the shunt *b* around the resistance *a*, and second, the presence or absence of the shunt of the line lamp about the supervisory lamp.

Fig. 4 illustrates clearly that at all times of a connection with a jack of the multiple, some current is passing from the armature of the line relay to the first jack bushing with which it is connected. Also, that at all times of no connection the jack bushings of a line must be at the full potential of the battery. A scrutiny of Fig. 4, therefore, will show that a tip of a plug as used for testing will also be at the full potential of the battery, because of the use of a split-wound receiver, and a connection of its middle point to the battery itself. No click will be heard, therefore, in touching the tip of the calling plug to the bushing of a non-busy line, while some click will be heard if a plug is in a jack of that line, whether or not a supervisory lamp be burning.

SMALL MULTIPLE BOARDS WITHOUT LAMPS.

For a variety of reasons it is sometimes desirable to install multiple boards of limited size without so highly organized a power plant as to render lamp signals wholly suitable. Fig. 5 illustrates the line circuit of such a board. The test rings of the various jacks for a line are connected together; the mechanical visual signals are located in a group by themselves, not adjacent to the jacks. A distinct disadvantage exists in this arrangement, because instead of merely reaching toward the signal with the answering plug, as in the case of a lamp associated immediately with the answering jack, the operator must know the number of the calling line, and then find the jack. In the particular type of switchboard illustrated by Figs. 5 and 6 no answering jacks are provided.

It will be seen that the insertion of a plug breaks both sides of the line circuit proper, removing the signal with its connection to the battery, and also the ground connection.

With the understanding that the three keys shown asso-

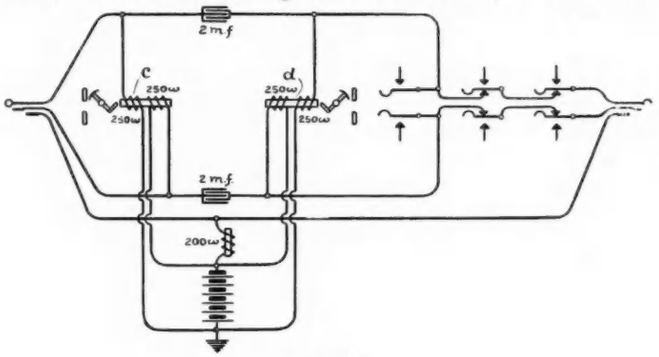


FIG. 6.

ciated with the right-hand plug in Fig. 6 are respectively a listening key and two ringing keys for party line purposes, and that these may be arranged in any other manner as may be desired for party line ringing, it will be seen that the principal features of the cord circuit as distinguished from those previously described in these articles are that, while the talking strands contain a conductor each, the current for the subscriber's transmitter is furnished, not by anything permanently connected to the line, but by a bridge winding permanently connected to the strands of the cord. Because the operation of the ringing key cuts off all cord circuit bridges behind it, these current supply bridges upon a cord circuit may be made of as low resistance as is desired, without interfering with the ringing of the subscriber's bell. A comparison will show that this is not true of the lamp multiple circuits described in this article, or in the November issue.

When current is taken by the subscriber during a connection, all that goes to his instrument must flow through the windings of the supervisory signal *c* or *d* in Fig. 6. It is evident, therefore, that if the signal is to be displayed at all, it must be during the time the subscriber's receiver is off the hook. This introduces an element of supervisory operation exactly opposite to the form which is considered the best practice. Indeed, it seems at first sight quite unlikely that an operator would recognize the disappearance of a signal to be a positive order to her to make disconnection. This seems the more likely when it is remembered that the supervisory signal story told to the operator by a cord circuit which has just completed a conversation, is exactly

the same as that told by a cord circuit which is not in use at all. By some mental process, however, operators do learn to interpret the operation of negative signals with great accuracy, and it may be said that there is no great difference to be determined between the work of skilled operators with negative signals, and skilled operators with positive signals. As all operators, however, are not skilled from the beginning of their work, positive signals are distinctly better.

With such simple switchboards as this, it is possible to operate the line and supervisory signals, and furnish a satisfactory grade of transmission with power plant voltages of widely different amounts. In very many cases, small exchanges to which such switchboards are suitable, are located reasonably near larger exchanges having highly organized power plants, and in most instances are connected to them by toll lines or trunk lines. It is a simple matter to equip the circuits in the small offices in such a way that current may be brought from the larger office over the trunk lines, either by special switching of the trunk line conductors at night, or by special arrangements which automatically convert the trunk lines into supply circuits during all the time they are not in use for trunk connections. This plan is something on the order of the arrangement which charges a battery in a private branch exchange over its trunk lines during all the time they are not in connection for conversation.

STUDY OF TELEPHONY AT PURDUE UNIVERSITY

Telephone engineering is the most valuable adjunct to the study of electricity ever introduced in a technical school of learning, and the experiment, which is now in its third year at Purdue University, at Lafayette, Indiana, has been proved successful. Telephony was introduced to Purdue by Prof. W. E. Goldsborough, who was chief of the department of electricity at the St. Louis exposition. He holds the chair of professor of electrical engineering and is director of the electrical engineering laboratory at Purdue. He is one of the best authorities on electrical engineering in the country, and it was because of his persistent efforts that Purdue first took up the study of telephone engineering.

At first it was an experiment at Purdue. Professors of other institutions of technicology scoffed at the innovation; friends of the institution stated that it was a useless expense, that one who learned the theories of electrical engineering could easily master the practices of telephony. But telephony at Purdue is a permanent department of the school's work. It is there to stay, and begins its third year with a great increase over last year's enrollment in its classes.

But the fight of its advocates is not over. The telephone trust employs graduates of schools of electrical engineering and is ready to testify that they make valuable employes. The telephone business is looked upon as a side issue, one that can be easily understood by a man who knows electrical engineering. But Independent manufacturers demand the output of Purdue's electrical school, because they believe that when a man knows electricity and telephony, too, he is just twice as valuable as the man who knows the one branch.

Prof. J. C. Kelsey is at the head of the department of telephone engineering at Purdue. He is a graduate of the University of Kansas and has had a practical experience extending over several years with both Bell and Independent exchanges. He has incorporated into the curriculum of Purdue a most vital department and his work has not been without reward. He has talked telephone engineering for technical schools until he has the Ohio State University thinking seriously of opening a department next year. The schools of technicology at Worcester, Massachusetts, will soon fall in line and those who have been preaching telephony at Purdue will see a general movement toward the introduction of the novelty in their schools of electrical engineering.

The unique study of telephony has attracted experts from all over the country. Manufacturing concerns at first lent aid by sending equipment, but now Purdue has passed beyond the stage of borrowing electrical and telephone apparatus. The university buys and is independent, uses whatever kind the faculty likes and students are taught to be impartial in their selection of equipment and to take only what they think to be the best. And there has been a demand for the work as well as for the output. Applications have been received at the university by men who want to take the two-year course in telephony. It is refused them because the department would become crowded with special students. The study is only a part of the course in electrical engineering. Juniors and seniors may take telephony in preference to thermodynamics and steam engine and boiler work. There are now twenty-five in Professor Kelsey's class and the prospects are bright for a 100 per cent increase next year.

A visit to the telephone laboratory at Purdue University creates the impression that nothing but automatic telephones are used. This, however, is not the case, as every switchboard imaginable is dissected, analyzed and studied from beginning to end. Every pattern of telephone is studied and the reasons for the many differences are explained. The introduction of the automatic telephone was a good thing for Purdue's department of telephony. In reducing the working force at the switchboard, doing away with the operators, it created a necessity for more experts to take charge of the lines and exchanges. Hence, the demand for experts having increased, the chance for employment of Purdue's output is always good.

The study of telephone engineering at Purdue is attractive and complete. The knowledge of circuits is the foundation of telephone engineering and the first year's work for the student is with the transmitters, induction coils and receivers and the methods of connecting them for service. The idea of the multiple takes root in the mind of the student after he has mastered the connection of the drop and jack, thus opening to his vision the connections of thousands of lines and telephones. Through one phase of telephony to another, past the common battery system, and the others that are in use, he reaches the automatic. It is the latest addition to the laboratory and is used by the advanced students. The students use a fully equipped four-party exchange, 1,000 lines ultimate, and the device is analyzed until thoroughly mastered.

TELEPHONE IN THE WHITE HOUSE.

One of the busiest spots at the White House is the telegraph and cipher bureau, which is never closed, day or night, year in and year out, and where hundreds of messages dealing with vital affairs of state and having to do with the welfare of a great nation are received or sent daily. In all, sixty-five wires converge in this room, and, including the president's private code, telegrams and cablegrams are sent in ten different codes.

President Roosevelt will not have a telephone instrument in his private office, but goes to the telegraph and telephone room in the White House, where he is frequently engaged in long-distance conversations for some time, as during the anthracite coal strike when he was thus engaged with the leaders of both sides, frequently for long intervals. The central telephone station in this room is so arranged that the President can talk with any government official in Washington without the message passing through the city central office.

The Electrical Fire Hazard

C. J. H. WOODBURY, Brooklyn Institute Arts and Sciences

THE applications of electricity for illumination and the conveyance of power have outstripped the merely relative conditions of superiority to existing methods, and have also reached beyond precedents to the establishment of new expedients. These vast enterprises have required the largest initial investments during the past twenty-five years. The use of copper and consumption of supplies taxed all available resources. It has been the greatest purchaser of copper, requiring the output of the old mines, and has stimulated the search for further productive deposits of this useful metal. The great usage of poles for aerial wires has been one of the elements threatening the forest supply.

The demand of electrical interests for a more economical generation of power at higher standards of accurate regulation has improved steam engines and water wheels, bringing out new types of both, which are also in other industries an advantage to users of power. The organization of power-generating plants upon a scale whose solidarity inspired confidence in patrons that the product was to be of assured permanence was of itself a new feature in construction. New tributary industries to fill the gap in insulation between those of submarine cables and electric door bells were established. The continuous operation of these plants required mechanism whose high standard of construction has stimulated collateral lines of mechanical production and uplifted the character of such work.

Employment has been given to thousands upon thousands, particularly those of high-skilled artisanship. It has established the new profession of electrical engineering, which has taken unto itself the best in the other branches of engineering, engrafting practical experience upon technical lore, for capital soon found that the useless labor of untrained minds was a most expensive venture. The pre-eminent service, however, in this development was that rendered by the administrative leaders in these enterprises, who made all things possible by the force of their imaginations, which enabled them to comprehend the possibilities of the future and to endow with confidence the investment of capital in the applications of science for which there were not adequate precedents.

ELECTRIC ILLUMINATION.

The introduction of electric lighting was never accomplished on the basis of cheapness, but on that of quality. Its advantages of brilliancy in illumination, revealing objects as at noonday, showing colors at their true value, applying the light without reference to the limitations of an exposed flame or the vitiation of air, are all of the highest value in artificial illumination and hitherto without precedent. It was of great value in all manufacturing, because the perfection of the illumination enabled the production of as good articles under artificial light as by daylight, and this has obviated the well-known differences between summer and winter goods in textiles, as the latter, when made to a great extent under gaslight during the short days of winter, contain a greater number of imperfections.

In some industries requiring accuracy as to color or delicacy in manipulation, the working day ended with the sunset. Whether it be measured by hours or by results, in all cases the use of electricity has added to the working day, and it has aided both the product and the toilers in the benefits resulting from the absence of any vitiation of the air, as is the case to a serious extent by other methods of illumination.

While the sentimental uses of electric illumination may not pertain to this consideration of the question, the fact cannot be ignored that its ministrations to the taste and comfort of humanity are contributions to the general good in the furtherance of happiness and contentment, even to the amelioration of the condition of the rich. The concentration of electric illumination without regard to the disposal of the products of combustion, as in the case of other illuminants, has been of great value in emergency surgical operations at night, which could not otherwise be performed except by waiting until daylight.

ELECTRICAL CONVEYANCE OF POWER.

The application of electricity to the conveyance of power followed that of lighting and did not reach a full development until the production of large generating units in later years gave scope to its utilities on an economic basis. This property of transferring energy without dynamic motion between the prime mover and the point of application to the machine has been of the utmost moment in the developments resulting from the removal of mechanical questions from the problems of power transmission.

It has given value to unused water powers and harnessed their energy to productive application hundreds of miles distant. It has modified mill design to the fundamental purpose of construction purely devoted to the operative machinery. It has changed the location of factories from that of an essential juxtaposition to the site of water power or coal supply, to those of freight facilities and centers of population available for labor.

THE GENERAL FIRE HAZARD.

This reminiscent sketch, indicating the extent and permanence of these achievements of electricity, is presented to call attention to the immensity of the work whose wide range gives rise to great problems when viewed from any standpoint and in any direction. These questions are so extensive that to treat any one of them equitably it must be considered conservatively. Among these problems, subsidiary to the main questions of construction, operation and administration, is the relation of electricity to the fire hazard, for it is a principle in underwriting that every material possession subject to insurance is to its uttermost details also involved with questions of fire hazard, both external and internal.

It would not be assumed by the lay mind that the stone reservoir which formerly occupied a portion of the park on Forty-second street and Fifth avenue, New York, was subject to a fire hazard, yet this structure was damaged over $50,000 by the burning of the Crystal Palace in 1856.

While diminishing the hazards of other methods of illumination, with their attendant mishaps from direct flame, the uses of oil, gas explosions, and carelessness with friction matches, it must be conceded that electric lighting cannot be claimed to be free from a hazard. Electric motors, in displacing gas and gasoline engines, or isolated steam boilers with careless attendants, cannot be assumed to remove all fire risk merely because they displaced the burning of highly combustible materials.

In diminishing the use of these methods involving perilous hazard, there remains the possible electrical hazard, for this energy which is normally converted into heat at high temperatures when it meets the resistance of arc or incandescent lamps, also produces similar temperatures adequate to ignite anything combustible whenever sufficient electrical energy is diverted from its normal conductors of low resistance and meets with a path of high resistance which converts into heat the portion of its energy devoted to the struggle for the maintenance of the circuit. Virtually the whole of the pre-

cautions for the maintenance of conditions of safety may be summed in the provisions for adequate conductivity and efficient insulation, but in their applications these provisions reach practically to every detail of all electrical plants.

THE UNDERWRITERS' RULES.

The early installations of electric lighting plants, whose circuits were upon uninsulated wires with earth return, caused numerous occurrences which naturally alarmed the underwriters. An investigation by a technical representative of a number of insurance companies and by those of the electric lighting interests was held, wherein the various incidents which had been the causes of fires were experimentally repeated, and new methods for the installation of plants prepared on behalf of the underwriters. It was thus noted at the very inception of the commercial applications of electricity to interior lighting that the hazards could be minimized by arrangements which would improve rather than impair the operative conditions of the plant.

The feature of divesting a process of its dangerous elements initiated a new principle in fire insurance which has been widely extended in the technical treatment of various hazards, particularly those of manufacturing processes. These electrical rules were extended along the lines of the advance of electrical applications, and various technical organizations, municipalities and local boards of underwriters, even individuals and manufacturers, prepared rules whose differences in unessential demands and deficiencies in specifications were sufficient to cause unnecessary vexation and frequent embarassment, especially to the manufacturing and operative electrical interests.

In March, 1896, the national conference on standard electrical rules assembled in New York for the purpose of preparing a code, embodying specifications covering the conditions of safety in a manner equitable to all the interests involved. This convention was composed of representatives of underwriters, of those engaged in the manufacture and operation of all varieties of applied electrical apparatus, and also of several scientific organizations. The various rules were diligently compared and their provisions criticized, and the reports of these meetings with an extensive correspondence containing suggestions were referred to a committee who prepared the national electrical code, which was adopted by the national board of fire underwriters and promulgated by them. Their committee of electrical specialists meet at stated times to make such amendments, generally by way of addition rather than alteration, as may be necessary to keep in step with the advancing conditions.

It is submitted that this code represents a wider consensus of opinion upon a question of science applied to the service of mankind than was ever concurrently given to any similar question. These rules are anomalous in their functions. They set forth conditions governing methods of construction, installation and operation of electrical plants, and their specifications receive the utmost consideration from those to whom they apply. Promulgated by the national board of fire underwriters, they form in their applications the guidance of inspectors of voluntary associations of representatives of insurance companies, and do not rest upon any jurisdiction which has power to enforce compliance with their provisions in any manner comparable with the power of the law. The work of the inspection corps is primarily suggestive in its nature, and as a division it is separate from the insurance rate making bodies, which, however, consider the electrical conditions in connection with other facts bearing upon estimates of risk.

In the consideration of the functions and jurisdiction of these rules, it must be remembered that there can be no exercise of authority without a corresponding measure of responsibility, and as these rules treat upon nearly everything connected with applied electricity, the situation year by year becomes greater and more complex. There is an approach to problems which in the near future may need a stronger body than a voluntary organization, whatever may be the individual constituency of its members to treat upon the large subjects arising from the congestion of various electric applications, and this administration of the national electrical code is being watched with interest, in comparison with that of the methods used under the authority of the law in various countries on the other side of the Atlantic.

It is no disparagement to the valuable work of the electrical committee in the advancement of standards of electrical installation and proscription of inferior methods to remark that in the confidence of equitable treatment, the electrical interests have co-operated with the underwriters in giving of their specialized skill towards the solution of the difficulties of hazard which have been raised. The improvements of their own apparatus have contained the suggestions of new rules. Slate switchboards made by electrical lighting companies inspired rules asking for slate switchboards; tubular fuses begat rules to match; telephone companies made protectors to defend their harmless plant, and protectors were demanded; power plants were equipped with circuit closers, and such devices became enruled. Study the evolution of these rules as one may, it will be seen that throughout the whole code the electrical interests were the pioneers in the means for the preservation of plant and the maintenance of continuous service.

All electrical interests appreciate the value of standardization of methods and expect a similar consistency in their application. It is not necessary in this connection to specify in detail the methods of providing conditions of safety, as this would approach a paraphrase of the code, which is a manual of over one hundred pages, freely distributed to all interested persons, and is familiar in its details to those engaged in installation or manufacture of electrical apparatus. Yet it may be worth while to refer to some of the general methods to which it applies.

AERIAL LINES.

The available routes for aerial lines are so limited that there are frequent instances of propinquity requiring every precaution to be taken to prevent cases of accident to poles or wires, such as would result from any contact between the high potential wires and those of other systems. The action of town, county, or municipal authorities frequently require locations of these various lines to be so near together as to be incompatible with conditions of safety.

A United States court has compelled the separation of lines of poles carrying telephone and extra high potential wires to a distance equalling that of the highest pole, so that in case of a broken pole or wire, there could not be any contact between the two systems. While such separation accomplishes the desired result, yet there are many places where there is not sufficient available space for such diverse routes. The Niagara Falls power line has a separate right of way, as have numerous other electrical power lines. In many instances, the owners of telephone and electrical power lines have mutually arranged to change their routes wherever necessary in order to provide sufficient distances between the several routes, and these agreements have been confirmed by the authorities; in other instances the permission for separation has not been granted. Wherever these various lines approach each other more closely than referred to above, then it is necessary to use every possible precaution against breakdowns, by the adoption of extra heavy construction, thoroughly guyed and braced as occasion may require.

However much the lines may be separated in their general routes, it is inevitable that there should be cross-overs. In such cases, it is desirable that the high potential wires should be above the telephone lines, as they are of larger diameter and therefore less liable to breakage, and being fewer in number there is the lesser chance of occurrences. The telephone linemen are so accustomed to the innocuous telephone wires that they may inadvertently neglect to observe the

proper precautions for safety if the high potential lines are below.

In a cross-over, the best condition is when the poles at the ends of the cross-over span are so much above the lower span that a wire breaking at an insulator on the upper span would not be long enough to reach the lower span. That the pole construction should be substantial and well guyed is an evident feature of these cross-overs. The end wires on the upper line should be covered by wire loops, known as end-insulator guards, to prevent a wire from jumping over the end of the cross-arm in case of the breakage of an insulator or other mishaps sundering the relation of the wire to the cross-arm. The wires at the ends of the upper cross-over span should be dead ended to double grooved transposition insulators, and the line completed by a loop to prevent overhauling in case of a broken wire.

In some instances where it is not feasible to make the upper span at such a great height as the above requires, then a screen of wood strips across a pair of suspension wires affords protection against a contact of the two lines. A joint pole does not afford a desirable means for a cross-over, as the whole construction is confined to a single pole, but where it is used, the upper line should have a transverse frame supporting guard wires and end guards to prevent contact in case of broken wires.

UNDERGROUND WIRES.

The obvious obstruction which overhead wires presented to the operation of the fire departments early gave rise to a public opinion in favor of placing the wires underground. This was far in advance of the state of the art enabling telephonic transmission through cables, and required the development of a new art in the production of underground conductors whose wires should be insulated in such a manner as to permit telephonic transmission, and also the development of the continuously drawn lead sheath. When this was accomplished the telephone wires were placed underground in cities, because the number of the wires was beginning to tax the possible pole capacity. The largest pole line carried 250 wires, and single cables are now made with 1,200 wires or 4 4-5 times as many circuits, and single underground conduits contain ducts for ninety cables, or over forty times the capacity of the largest pole line.

Underground wires were not a refuge for safety from the troubles of overhead lines, for they have difficulties of their own. They are a target for pick and crowbar of laborers on other underground work in cities. Street rollers have crushed them, and strokes of lightning have not only wrought havoc with their wires, but fused them in the ducts. The insinuating leaks from gas mains penetrate ducts and manholes, where they cause destructive explosions.

In times past when attractive propositions of municipal action or other relations caused joint conduits with high potential wires in the same underground system with signalling wires, the electrical leakages of the former were the cause of numerous destructive crosses. The Supreme court of New York has decided against this manner of joint use of a conduit system.

ELECTROLYSIS.

The chemical effects of electricity are well known as a most active agent in industrial chemistry, particularly in electrotyping, where metal is removed from one mass and deposited upon another article. Electricity is used to make and to break molecular combinations in many lines of chemical industry, as the manufacture of aluminum, sodium and other metals, also carbide of calcium, soda ash and other compounds. In like manner with the single trolley railroad system the portion of the electricity passing through the earth between the moving cars and the ground plate at the central power station applies a portion of its energy in making various chemical changes in the earth, many of them to the serious detriment of underground pipes and electric cables.

Any impairment of underground water pipes to the point of rupture is certainly a live issue in the question pertaining to fire hazards, and hardly less so is any injury to underground conductors connected with the fire alarm or the telephone systems which are such essential features in the reduction of the fire loss, by the prompt manner in which they are able to summon the fire department. These underground currents remove metal from such buried conductors, and also form caustic potash and other alkalies by the electrolysis of alkaline sulphates or chlorides. If these are formed near to underground conductors they are not corrosively active upon them until the generating current ceases or is greatly reduced.

Metallic sodium has been formed by the dissociation of sodium hydrate in cement by currents of electricity and such events have occurred in buildings where the presence of moisture caused the rapid oxidation of the sodium, producing heat which set fires. The magnitude of these underground changes may be noted from the large masses of these electro-deposited materials, sometimes a yard in diameter, which become attached to the ground plates at central power stations.

The method of preventing the destructive effects of electrolysis is to attach the positive side of the generators to the trolley wire so that the return current tends to build deposits upon the underground conductors beneath the area traversed by the moving cars. In the vicinity of the power house the destructive effects of the current leaving the underground pipes and cables for the ground plate would be more active than under any other condition of affairs unless conductors reached to the ground plate from such of the pipes as were positive to the earth. The arrangement of these connections is made from the data of surveys of the electric potential of various conductors to the earth; where it is negative, metal is not being removed from the pipes, and where the electric polarity is positive there is need of bonding to the ground plate.

New electric lines or bridges alter these conditions so that frequent surveys are necessary to preserve the conditions of electrical neutrality. The new East River bridge and the introduction of electricity as a motive power on the elevated railroads made many changes in the potential map of New York city, in which the lines of equal potential were drawn like the contour lines of equal elevation upon the map of a hilly country, the positive area near the power station being shown in a dark tint. This line of treatment will stop further destructive results from return currents if applied along these lines, but it is necessary that the work should be done properly, and a constant espionage maintained to reveal changed electrical conditions.

INSIDE WIRES.

There is no department of electrical construction which is less properly the subject of amateur work than the inside wiring, and none which has been the purpose of more misapplied industry, with the expected adverse results. There is more constructive detail to the design and arrangement of inside wires than can be taken into consideration at this time. The essentials of wires of ample conductivity are established by a table of sizes, which limits the possible rise in temperature of any wire about thirty degrees Fahrenheit. The selection of insulating material is based upon its exposure to water and dampness. The possibility of contact with other conductors must be prevented by tubes or other methods of guarding, especially when passing through floors or other portions of buildings.

In manufacturing buildings, the wires may be placed upon suitable fixtures, but in commercial buildings and residences where they would be unsightly, they are drawn into pipes run through the walls and floors. The modern architect leaves channels in the walls and floors for such tubes, as is done for water and steam pipes. These tubes are to protect the insulation from injury, but they are not insulators.

The switches in electrical systems are the subject of care-

ful design, in order to provide that the several conducting parts will be of ample conductivity when closed, to convey without heating the currents to which they may be subjected, and whose operation is such that they shall not form arcs when opened.

The most important part of a lighting plant consists in the safety fuses, which are pieces of easily fusible metal introduced in the circuit, and of such dimensions that they will be melted by the heat resulting from an undue excess of current. These safety fuses were first made for the purpose of protecting the filaments of incandescent lamps from destruction by slight increases in the current, and afterwards applied for the broader purposes of protecting a whole system, by opening the circuit whenever the current exceeded its normal quantity. The heat at the instant of deflagration is sufficient to vaporize a portion of the metal, and to throw around small drops in a state of fusion. This in itself would be a cause of fire if the fuses were exposed to combustible material, but for interior wiring it is necessary that they should be suitably enclosed.

The use of open fuses on the motors of street cars has been the cause of numerous fires in transit. The first line of improvement was to enclose the fuses in tubes, and the violence of the deflagration would heat air sufficiently to rupture the arc, and aid to the efficiency of the operation of the device. This was followed by methods of reducing the volume of air by means of asbestos braid around the fuse, or filling the tube, except a small air space at the middle of the fuse, with a powder or refractory material, which would not be vitrified by the heat of the arc. These methods reduced the violence of the detonation and also permitted the more accurate calibration of these protectors.

FIRE ALARMS.

Any allusion to the fire hazards of electricity would be seriously defective if it did not make mention of the work of the same agency directly in the benefit of the reduction of the fire loss, through the alarms given by the signalling systems. The electric fire alarm, when first brought out, did not receive any serious attention until the city of Boston bought the territorial right of the patentee, and the results immediately became so valuable that similar alarms were installed throughout other cities. The automatic fire alarm systems, in spite of their excessive complications, have been of great value in the concentrated large risks in cities and large manufacturing establishments.

Every telephone is a fire alarm, by which the unskilled can at once state to the fire department the details of place and condition of the occurrence. There is a secondary hazard to these signalling systems, owing to the fact that in the ertent and ramification of all electric wires there are liabilities of mishap when through accident there is contact of the wires of different systems, and lighting or power currents are imposed upon the delicate apparatus of the telephone system.

PROTECTORS TO SIGNALLING SYSTEMS.

At the ends of the telephone lines destructive results from such foreign currents are prevented by apparatus which is subdivided into the various functions which it performs, for there has not been thus far any single device of defending the telephone instruments against the whole range of commercial foreign currents and lightning to which they are subjected. The form of apparatus used by many of the large telephone companies consists of a device which is threefold in its nature, inserted in each line wire. The first element consists of a fuse made of an alloy which forms part of the circuit, and is contained in a tube of vulcanized fiber. These fuses will deflagrate when exposed to currents of seven to ten amperes, the capacity of the fuse being varied according to the type of the apparatus.

The next element consists of a pair of small blocks of carbon whose larger surface measures about one by one-half inch, and one of these blocks is connected to the telephone circuit. The corresponding block of the pair of carbons is separated from it by a perforated sheet of mica and is electrically connected with the earth. A small cavity in one of the opposite faces of the carbon is filled with a button of solder such as is used in automatic sprinklers, and which melts at 160 degrees Fahrenheit. The distance between these carbons, or the thickness of the mica, is .0055 inch, being such that electricity at over three hundred and fifty volts will pass from the carbon connected with the telephone circuit across this space to the opposite carbon and thence to the earth, thereby relieving the telephonic apparatus of electric tension exceeding 350 volts. Thus, if the foreign current exceeds the carrying capacity of the tubular fuse, its deflagration opens the circuit at that point. If, however, it is less in volume than the carrying capacity of the fuse, and over three hundred and fifty volts tension, it leaps across the thin space separating the carbons, and thence passes to earth. The resistance of the tiny arc in the space between the carbons is sufficient to slightly warm the carbons, and cause the fusible metal to flow from its recess and fill the space between the carbons, and thus establishes a conductor of low resistance to earth.

This diminished resistance generally causes a sufficient increase in the current imposed upon a line to cause the tubular fuse to deflagrate and open the circuit, if it did not do so on the first occurrence of the contact which imposed the foreign current on the telephone circuit. At the subscribers' telephone installation the fuses and generally the carbons are placed in the building near to the point of entrance; but in order that the wire leading to the ground shall be as straight as possible, because lightning does not like to follow turns and bends in a conductor, it is sometimes necessary to place the carbons at some other place along the route of the wires in the building. This separation of the parts is required very infrequently, on an average of about one telephone in twenty.

In order to protect the fine wires of the telephonic apparatus from injury by currents which are too small to operate the tubular fuse, and of too low tension to pass to earth through the carbon cutouts, a third element, known as the heat coil, is employed, in which a fine German silver wire which forms a part of the telephone circuit will be heated by a current of one-sixth of an ampere to a temperature sufficient to release a conductor ordinarily secured by fusible solder, and pass the current to earth. This latter device is not used at the subscriber's end of the line in those modern types of telephonic apparatus in which the circuit is normally open, except when the telephone is in use, because such coils are an interference with the best conditions of telephone service by adding to the electrical length of the line, and if a foreign current came in contact with the telephone line at a time when the instrument was in use, it would produce noises which would absolutely prevent the transmission of speech, and the user of the telephone would naturally place the receiver on the hook and thereby open the circuit.

The result of this protective apparatus has been so successful as to establish conditions of immunity against mishaps to the apparatus resulting from foreign currents, and lightning. Such a telephone office appears to be, like a locomotive, the safest refuge in a thunderstorm. Notwithstanding the number and range of location of telephone central stations, it has not been possible to obtain information of any injury by lightning to any person in such a place.

Whenever the distribution of the telephone service is entirely underground, this system of protection is not necessary at the subscribers' instruments, but is in all cases installed at the telephone central office to protect the whole system against foreign currents imposed upon other parts of the system.

THE UNDERWRITERS' ELECTRICAL BUREAU.

The whole foundation of fire insurance, which is said to be the second single tax in this country, is based upon a distribution of averages, and in that examination of facts which is the foundation of science, the allotment of the various losses both as to cause and amount is the subject of systematic tabulation, whose results furnish the basis upon which insurance rates are levied, for the old method of competitive guessing is a matter of the past. The causes which contribute to the origin of fires are largely those of chemical reactions, while the resistances to fire are dependent upon construction and fire apparatus. Thus the modern method of fire loss prevention is a technical proposition requiring the services of chemists and engineers.

The national board of fire underwriters maintains a testing laboratory which contains the necessary facilities for making the various investigations required in this study of matters pertaining to the fire hazard. It is here that the supplies and subsidiary devices of commercial electricity are put to their proper tests, and the results have great weight in furnishing additional features to the national electrical code. Their quarterly reports, containing lists of fires caused by electricity, and stating the deviations from the code which are supposed to have been the origin, is a compendium of exact information on the subject.

The Associated Factory Mutual Insurance Companies of New England were pioneers in the application of technical work to the reduction of the fire loss, a task whose beneficent results have extended beyond the mills which form the specialty of this combination. The underwriters assume a great task in undertaking to maintain inspection properties over anything as widely extended and as numerous in detail as the commercial applications of electricity.

The results show beyond peradventure that the electrical fire hazard is less than that of other methods of lighting and power transmission, *while every telephone, being a fire alarm, the signalling systems are potent elements in the reduction of the fire loss.* While the diminution of the ratio of such fire losses appears to be due to this work, as the variable element in the problem, the question naturally arises, will the future permit its continuation to an extent which will be equal to the greater task of meeting the problems of depreciation of plant, and the congestion of the future to which the present applications of electricity are a mere preface. If the work remains in hands which can exercise the responsibilities to a uniform jurisdiction, then it will be sustained by the dominance of an approving public sentiment.

TO FIND ORE BY TELEPHONE.

B. L. White, a western electrician, with two companions, will leave Salt Lake March 1 on a prospecting tour, in the course of which he expects to demonstrate the value of an electrical ore-finder, which he has but lately perfected. He and his companions will go directly to Caliente, Nevada, and will prospect the country lying between that place and Goldfield.

Mr. White has been experimenting for a number of years with the idea of using electricity as a means of detecting the presence of certain mineral ores invisible to the eye, basing his theory on the difference of the electrical conductivity of the earth, due to the presence of metal ore. Copper being one of the softest of the known metals is, of course, the best conductor. Most other metals, although harder than copper, also show less resistance than the earth and rocks in which the ore is imbedded.

His first experiments were with a galvanometer and Wheatstone bridge, which equalizes the resistance of the earth to a stated number of volts. Finding that this would not give the desired result, he turned his attention to the idea of a telephonic transmitter and receiver, which would indicate the location and the kind of ore to the operator by registering the different sound-waves of a current passing from the positive to the negative pole, the two electrodes (poles) being planted in the ground on either side of the supposed lode or tract to be prospected.

The first trial of this method was made last spring in Red Butte canyon, near Fort Douglas. On account of a subterranean stream under the hills prospected the trial was productive of no results beyond demonstrating some technical points regarding the construction and adaptability of the invention. After a year's experimenting with this apparatus and many failures, Mr. White now has a machine with which he claims that not only can deposits of ore be located, but the length and depth of the lode can be determined with an accuracy not obtained by any other existing system of prospecting. In describing his invention, the inventor says:

"In the White system there are two stations, the transmitting and the receiving. At the former there is a battery of six volts, a special form of breakworks and a glass condenser. The current is led through the primary by an inductor, a special form of induction coil having a large core and very heavy winding in the secondary circuit. The current now passes through the secondary condenser to adjustable parallel spark gaps. The electric waves generated by this arrangement are taken to the earth by means of two iron spikes driven several feet into the ground. The receiving set comprises two similar spikes connected up to an induction coil and telephone receiver. By listening in this receiver the operator detects the varying sound waves as they pass through any ore concealed in the earth."

The description shows the simple fact that a current generated by an attached battery either does or does not pass freely between the two electrodes (or poles) which are planted in the ground to be prospected. Whether this current is impeded by the absence of ore, aided by its presence directly between the electrodes, or broken by the ore being out of a direct line between these poles is clearly and surely indicated to the operator in the sounds registered by the telephonic receiver attached. In speaking of the operation of his machine by others, Mr. White says:

"It will, of course, be necessary to train mining engineers and prospectors in the use of the instruments and in the detection of the presence of the electrical sound waves. The whole outfit is, however, simple and easy to work and anyone who has the most ordinary knowledge of electricity could in a very short time become entirely familiar with it."

Prospecting is, of course, a very inexact science in its present state, and the mining world would certainly welcome with open arms a system of ore finding which could be relied on. If this invention proves its practicability in actual usage, it will go far toward lessening the great annual loss entailed in making borings which prove unsuccessful and opening up lodes that turn out not sufficiently promising to continue working.

ANOTHER OCEAN TELEPHONE.

Prof. Howard D. Minchins of the University of Rochester has made a crucial test of an invention of John Dennis of Rochester, New York, to overcome line impedance in telephone service. Prof. Minchins says: "The invention means telephoning across the ocean or from New York to San Francisco with no more difficulty than from one street to another. I have made tests of the appliance under five different grades of impedance. In each case the application of the new force was entirely successful. The new appliance is inexpensive and is entirely practical for commercial purposes."

DIGEST OF TELEPHONE PATENTS

Conducted by Edward E. Clement

762,348—R. H. Polk. Guy Anchor.
762,842—R. H. Polk. Ground Anchor.

Owing to press of other matters and lack of space, these two patents were not digested upon their issue some time ago, but as the Polk anchor is now on the market they may prove of interest. The device in each case comprises a rod with a blade or blades pivoted to the end thereof, so that the whole device can be shoved down into an oblique hole previously bored into the ground, as shown in the figure herewith. When the strain comes on the rod from the guy wires the blades open out transversely to the rod. Claim 1 of the second patent reads as follows:

"A ground anchor, comprising a body portion and a disc blade extending from said body portion in the same horizontal plane."

Other claims specify more than one blade, and an alternative form is shown having a pair of spoon blades. The device is simple in conception and should be quite efficient in operation.

774,608—W. A. Shackelford. Attachment for Party Line Telephone Systems.

This is also a party line system, but it lacks the viciousness of the former one. It has one noticeable feature which may or may not be welcome to those connected on long country lines and fond of a bit of gossip. Mounted over the switch-hook at each station is a gong striker adapted to be tripped when the hook goes up, to strike the gong, and as the patentee naively says, "to make a loud noise on the line." It would be worth the price of admission to see Farmer Jones' face and hear his remarks the first time he tried to listen in with this kind of a telephone. I would also like to hear the neighbors' remarks. But everyone can imagine them for himself.

The only other salient point in the patent is the provision of a switch at each station for cutting off the line beyond, this being tied to the switch-hook by a string, so that when the receiver is hung up the switch arm is restored.

774,770—Kempster B. Miller. Central Energy Telephone System.

This system contains a number of features found in the commercial output of the Kellogg Switchboard and Supply Company, to whom the patent belongs. The application was filed December 19, 1900. There are thirty-three claims, of which the first twenty-six include as an element a differential supervisory relay, but the last seven cover broadly some of the most salient features of what afterward developed into the Kellogg two-wire multiple circuit.

Briefly stated, this circuit comprises metallic subscribers' lines, normally disconnected from the jacks and connected on one side to ground and on the other to the line signal. The cut-off relay for each line is in a local circuit, connected on one side to the live side of the main battery, and grounded on the other side in the jack when a plug is inserted. This cut-off relay when energized takes the line terminals off the signal and ground and puts them on the jacks. The cord circuit has two conductors only, with an interposed repeating coil and two main batteries, one bridged across each end of the cord between the two halves of the repeating-coil-winding connected thereto. A point is made of the fact that the cut-off relays are fed from the same batteries which feed through the cord to the lines.

The most striking feature of the cord circuit lies in the arrangement of the supervisory relays. Each relay has two differential windings connected in opposite sides of the cord, so that current flowing from the bridged batteries over the metallic circuits will not energize the relays. When a subscriber hangs up, however, he grounds one side of his line through his ringer, and the supervisory relay then gets current through one winding only, and pulls up its armature to light the lamp.

In the diagram *c* is the line signal, *b* the cut-off relay, and *h'-h2* the supervisory relay. *r-r'* are the main batteries bridged, as described between the windings *w'-w2* and *w3-w4*, also supplying the cut-off relays *b* over circuit *3*.

774,923—D. W. Troy. Receiver for Telephones or the Like.

Primarily, the invention herein disclosed is a "loud speaking telephone receiver," along somewhat similar lines to those of Edison's electromotograph, in which a chalk cylinder moistened with an electrolyte is revolved in contact with a metallic strip connected with the diaphragm and the friction between cylinder and strip modified by the current impulses passing through them. Mr. Troy says he seeks to avoid the inherent effect in the Edison apparatus of foreign vibrations due to roughness of the chalk cylinder. He provides a permanent magnet with a rotary pole piece, and resting upon this is a small armature connected to the diaphragm. Cohesion between this armature and the wheel is varied magnetically by a coil acting on the magneto armature and connected in the talking circuit. The wheel is made very smooth, and is constantly driven by some suitable motor.

774,929—W. M. Bashlin. Protecting Diaphragm for Telephone Transmitters.

This invention, if it may be dignified by that title, comprises a thin elastic membrane stretched over the end of a mouthpiece and held there by a ring clamp having set-screws taking over the edges of the mouthpiece.

774,991—G. S. Nickum. Register for Telephones.

This is a simple and very neat design for a register worked by the subscriber. It comprises a short tube *C* threaded at both ends, one end screwing into the front plate of the transmitter, and the other end taking the mouthpiece. The tube has a drop carrying the register *E*, which comprises a circular casing internally connected through the drop with the tube *C*, this containing a cyclometer register *F*, worked from the outside by a key *G*, through the rotating spindle *d*. On the spindle are three pins *h*, which when the spindle is turned snap past the teeth of a comb *i* attached to the casing. A stop pawl *g* prevents backward turning. In use, when the subscriber is using the instrument the operator instructs him to register before she completes the connection, being able to tell when he has done

this by the sound of the pins snapping past the spring. The feature of the device which recommends it most is its simplicity and its applicability to any transmitter, without tools and without trouble. The spring comb *i* is supposed to be tuned, and on a party line there may be different numbers of reeds, or they may have different tones to indicate to the operator the different stations.

775,145—W. Meyer. Electromagnet.

The application on which this patent was granted was filed August 26, 1901, and the patent is assigned to the Kellogg Switchboard and Supply Company. This statement is unnecessary to one familiar with the device as manufactured by that company. It comprises a straight core with a flat extension *32* extending up at the rear end of the coil and along the latter to the front end thereof, where it carries the bent armature *30*, secured in place by a single stud and check nut. The contact springs lie along the top or metal frame and are worked by the flat arm of the armature. The claims are of considerable interest. Claim 2 is as follows:

"In an electromagnet, the combination with a magnet core of a bar of magnetic material connected therewith at one end, and an angular armature poised upon and in contact with the other end of the bar and adapted, upon being attracted by the core, to form a closed magnetic circuit with said core and said bar."

There are fifteen claims in all, claim 6 and others being directed broadly to the idea of having a bent armature rocking upon an edge.

75,201—W. R. Whitehorne. Telephone System.

This is a selective lockout party line system. The usual transmitter, receiver, ringer and switch-hook are provided at each station, with a local battery for each transmitter, and the usual induction coil. At each station is a differential relay having its two windings respectively connected in the opposite sides of line, one winding having more turns than the other, and these turns being so proportioned at the different stations that any particular station may be selected by properly proportioning resistance between a source of supply and each of the two line wires at central. The local batteries are used for calling in, a most complicated system of relays, armatures and switches, is proposed for each sub-station, the call bells or ringers being in local circuits, the local talking batteries being supposed to furnish current for these as well as other devices. At central the line passes to "a polarized circuit-breaker," and the switch employed is a good deal on the order of electric lighting or heavy telegraph apparatus. The switch has several segments connected to one side of line and a solid bar for the other. Between the sectional pieces are bridged coils of different resistances. By plugging into the proper section therefore the current can be properly divided, it is supposed, to energize the differential magnets at all but the desired station, and to produce a perfect balance thereat.

The inventor of this system may be a telephone man, but if so his practical experience must have been very limited, and certainly the matter has been badly mangled in its presentation, principally through the lack of a proper diagram, but partly at least through the lack of anything upon which a good diagram could be based.

75,226—H. G. Webster. Telephone Exchange System.

This is a common battery two-wire multiple system, employing a differential cut-off relay, a pair of supervisories for the cord, and a common control relay for the supervisories. The differential windings *14-15* of the cut-off relay *16* are connected in series from the line wire *2* to the grounded side of battery. An intermediate point of the windings is connected to the test thimbles of the jacks. Two armatures are given this relay, one opening the local lamp circuit at *20* when attracted, the other shunting one of the differential coils *14* so as to cut the test thimbles onto line direct without the impedance of an interposed coil. *9* is the line relay, which remains connected, the cut-off merely opening the local line lamp circuit. Supervisory relays *29* and *30* control the lamps *35* and *36* as usual, and relay *33* supplies current to the local circuit for said lamps only when a plug is in a jack.

775,227—H. G. Webster. Telephone Exchange System.

This is another common battery two-wire multiple telephone system. The circuits are very similar to those in the case just noted. Current flows to line when a subscriber calls, through the differential windings of the cut-off relay in series, and when a plug is inserted the windings are unbalanced, the armatures pull up, the battery connection is broken on one side and the line signal together with one side of the cut-off relay winding is shunted, so that the jack contacts are directly connected to line. The principal difference between this and the other case lies in the present cut-off relay breaking the line connection on one side to the battery.

775,228—H. G. Webster. Telephone Exchange System.

This is a very similar common battery two-wire multiple system, the entire series of patents here presented proving the aptness of Mr. Webster, and the opportunity afforded by our patent laws to ring eternal changes upon the same combination of elements, getting a patent for each new permutation. Herein the line is normally connected again through the differential windings of the cut-off relay to the battery, and on the other side direct through an impedance coil. The supervisory relays and the controlling relay in the cord are the same as before, the latter being energized by the same current which upon the insertion of a plug unbalances the cut-off relay and causes it to shunt one of its own windings as well as the line signal. A common form of test is employed.

775,229—H. G. Webster. Telephone Exchange System.

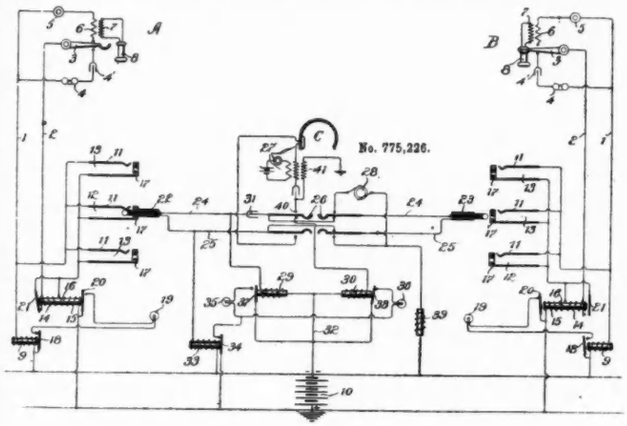
This is another specific permutation of the same elements. Here we have a differential cut-off relay and a line relay having divided but cumulative windings. The coils serve as impedance and are never cut off, the cut-off relay shunting one of its windings when it pulls up, and breaking the local lamp circuit. This action is produced as before, and the cord circuit and test are substantially the same.

775,230—H. G. Webster. Circuit Changing Apparatus.

This is a relay of the now standard type having contact springs lying along its frame, and an almost complete magnetic circuit. The scheme is simple. The core has upwardly projecting ends, and a straight armature as long as the core is hinged by a flat spring to one pole and extends over the other one, having a limiting or stop screw set therein. The springs lie along the opposite side of the relay from the armature, and between the long operating spring and the end of the armature extends a rod or pitman *16*. The principal virtue of this relay seems to be, apart from its promised efficiency, that it is not a Kellogg relay. All of these Webster patents are assigned to the Stromberg-Carlson Telephone Manufacturing Company, the applications having been filed during the year 1903.

775,254—G. W. Sebastian. Adjustable Support for Telephone Receivers.

This is a simple metal bracket arm pivoted at one end to the wall or desk set and at the other carrying a cradle in which the receiver rests. Near the pivot end an arm extends out at right angles in such fashion as to strike and press down the switch-hook of the telephone set as the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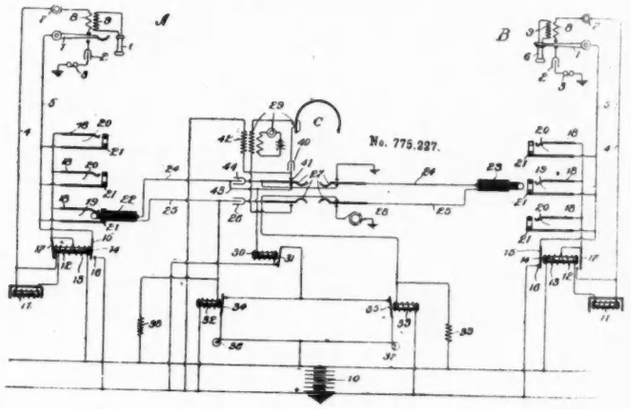
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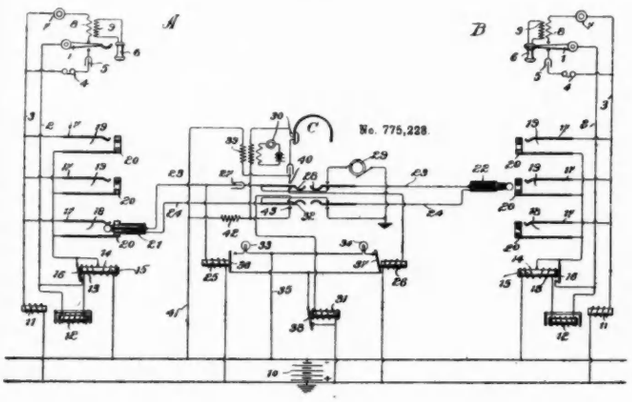
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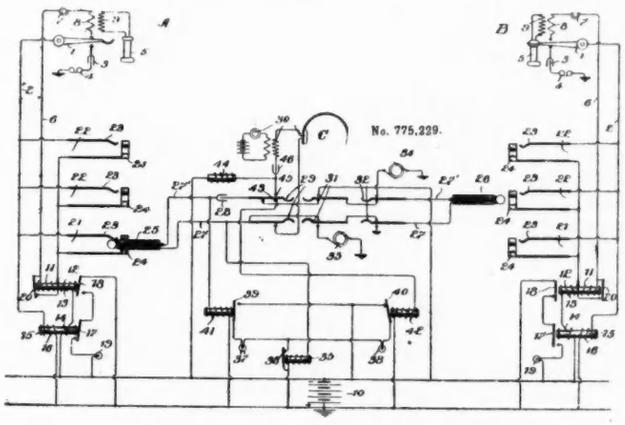
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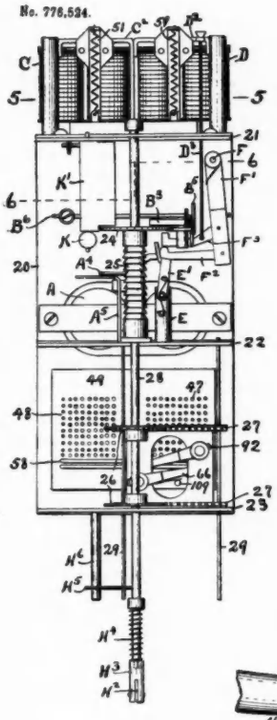
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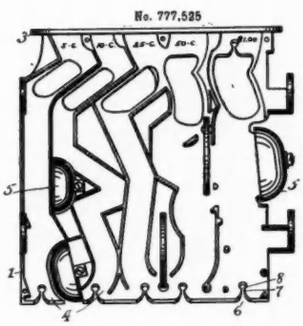
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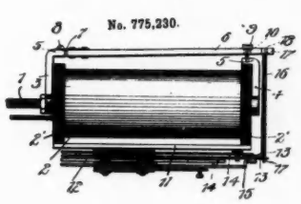
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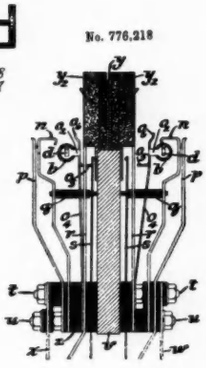
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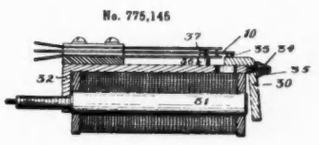
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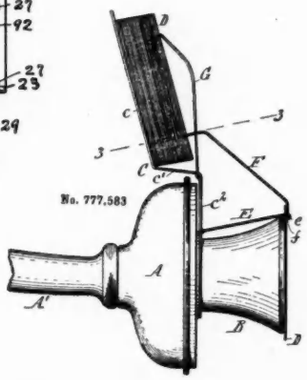
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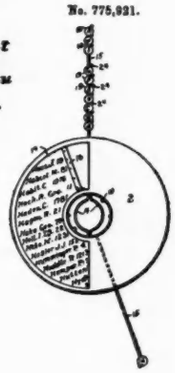
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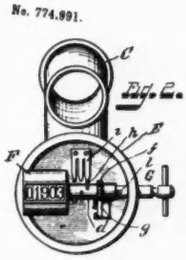
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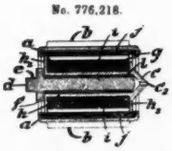

No. 776,218.

receiver is thrown up out of use. The general outline of the device is like the letter "L," pivoted at the angle.

775,337—R. L. de Moura. Wireless Telephone.

Roberto Landell de Moura is in Holy Orders, and hails from the Republic of Brazil. He speaks no English, but his diagrams are in a universal language. He employs the violet and ultra-violet rays, projected through the ether, to provide a path or preparatory medium for the transmission of other rays or waves, such as sound waves impressed upon light rays. The apparatus he describes is rather complicated, but it is to be noted that he provides a practicable call by using a coherer controlling a "howler" made up of a transmitter and receiver in a local circuit.

A romantic feature of this series of inventions is that Father Landell is supposed to have made use in his experiments of some of the wrecked searchlight apparatus of certain Spanish warships, thereby beating the flaming sword of war into a ploughshare for the field of knowledge.

775,521—G. M. Crockett. Telephone System.

This is another party line telephone system. Inventing such systems may be healthier than experimenting with perpetual motion or slaving in the Cracow salt mines, but it is hardly more productive. There is a superabundance of energy in our American people, and I feel certain that if some tribes of animals, say mosquitoes, were as well endowed in this respect as the great American inventor, and bit as often, all humans might as well immediately get their passports for the next stopping place.

In the present case a pair of wires lead out to a plurality of stations. A relay is provided at each sub-station to cut-off connections toward or away from central. If the farthest station on the line calls, the intermediate station relays all act to cut off; if the nearest stations calls the ultimate relays act to cut off, and if an intermediate station calls the relays on both sides of it work in series to cut off. The ringers are in ground taps, and their circuits are controlled by separate relays of their own. If two subscribers on the same line wish to converse, the calling party hangs up after calling, so as to give central the line. The operator then selectively calls up the proper party (by plus or minus pulsatory current over one side or the other of the line) and then the first party takes down his receiver again and uses a special push button to get himself in on the line.

The operation of systems like this seems too much like the German schemes, where there were seven things a subscriber had to do before he could get a connection, and the time consumed was more than seven minutes.

775,846—R. L. de Moura. Wireless Telegraph.

This is another of the group of inventions of Father Landell to which I have already referred. The same "howler" call is employed herein, and the apparatus is generally the same, a local circuit being provided for the howler, controlled through a coherer. During the transmission the coherer acts as a microphone. The Father claims a set of Hertz wave antennae, a source of cathodic waves, and a source of actinic waves, means whereby the changes of a pre-arranged code may be impressed upon one or more sets of the waves, and means to direct them toward a distant station.

775,921—H. M. Hile. Telephone Call Teller.

This is a half-moon directory stuck on the mouthpiece of a transmitter. One-half of the casing, *2*, is closed in, and the other half *14* is open. A set of semi-circular cards is housed in the closed portion, whose edge is open, however, so that a set of finger pieces *15* can stick up, each bearing the letter of its card, so that you can pick out the proper letter of the alphabet and by turning the finger piece *15* around you can swing the card into the open space and expose the names on it.

776,067—M. G. Kellogg. Multiple Switchboard for Telephone Exchanges.

Some time in 1897 Milo G. Kellogg extracted from the patent office a matted mass of interwoven claims carried by 127 patents. Several very good men, among them K. B. Miller, essayed at different times to digest that remarkable bunch of trouble, with a degree of success comparable only to the degree of satisfaction the task awakened in their bosoms. There were several cases of Mr. Kellogg's which did not escape with the rest. This is one of them. They all belong to the Kellogg company. The present application was filed November 30, 1891, and was issued November 29, 1904, hence as an application it was exactly thirteen years old. This may or may not be significant.

On its face the diagram shows two metallic circuit lines connected to multiple spring jacks and each provided with an impedance coil and signal in a ground tap. The connecting cord circuit has a ground tap from one side, containing a clearing out annunciator and battery. At each subscribers' station a ground is on when the hook is down, so that when one or both subscribers hang up there will be a flow of current through the clearing out annunicator from its battery, which will operate it. The connections are made, that is, the plugs are inserted right side up with care, so that the line branches and the clearing out branches come off opposite limbs and the battery for the latter is so proportioned that no signal will be given until the subscribers have hung up.

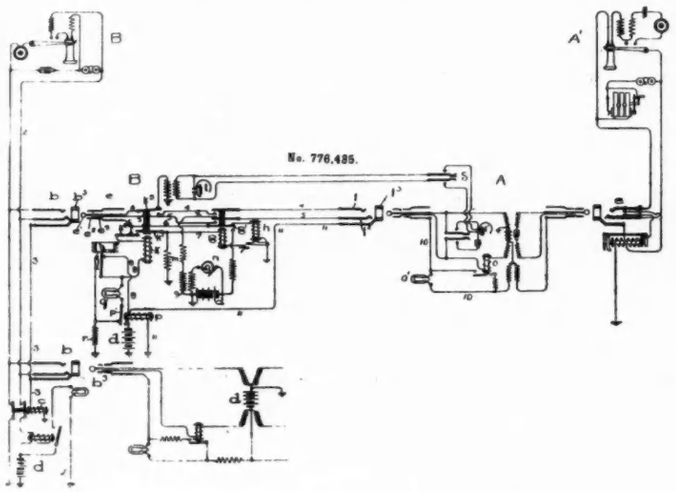
775,068—M. G. Kellogg. Multiple Switchboard for Telephone Exchanges.

This is another one of the same bunch. It was filed in July, 1893. Each line is connected to multiple jacks, and has a permanent ground connection from one side containing the line annunicator, the connecting cord circuit having a clearing out annunciator bridged across its strands, this latter annunicator being of low resistance compared to the line annunicators, which are high. The claims are directed to covering this arrangement rather broadly.

776,090—W. C. Runge. Telephone System and Apparatus Therefor.

Several years ago one Nye traveled around the United States of America organizing branches of the Standard Telephone Company and promising all sorts of things in order to get subscriptions to stock. Then the Standard companies exploded, except one or two where there happened to be some men with more determination than usual. However, the same gentleman afterward met up with Albert K. Keller, who used to be Edison's right-hand shop man many years ago, and engaged Keller to get up a telephone outfit for him which he could take to England to work a virgin field. Mr. Keller produced an outfit which was patentable, and patents were obtained therefor in many countries. All of which is of interest because some of the pictures of apparatus in the present case are apparently taken from the Nye-Keller apparatus. Mr. Runge is from London, but is an American citizen.

The system may be briefly outlined as follows: When the subscriber calls he momentarily grounds his line, and thus current from a grounded battery at central pulls up the line relay armature, which is immediately caught by a mechanical latch. Its lamp, therefore, remains lighted until a plug is inserted, when the latch is tripped thereby, and the lamp goes out. In the cord circuit is what the patentee calls an "engaged" signal or lamp. This is a supervisory lamp having its circuit closed when both subscribers have answered. In one figure the usual pair of supervisories and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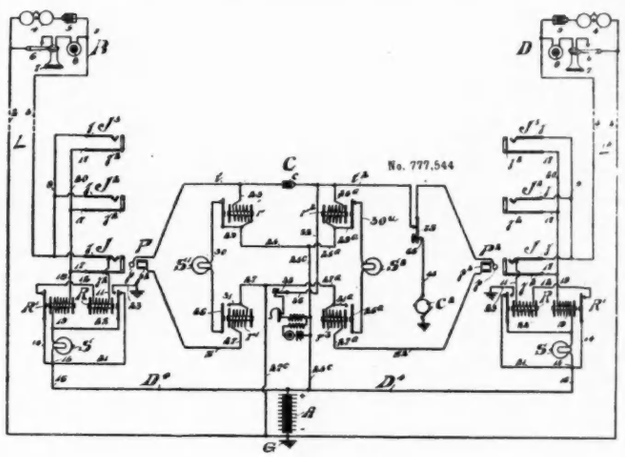
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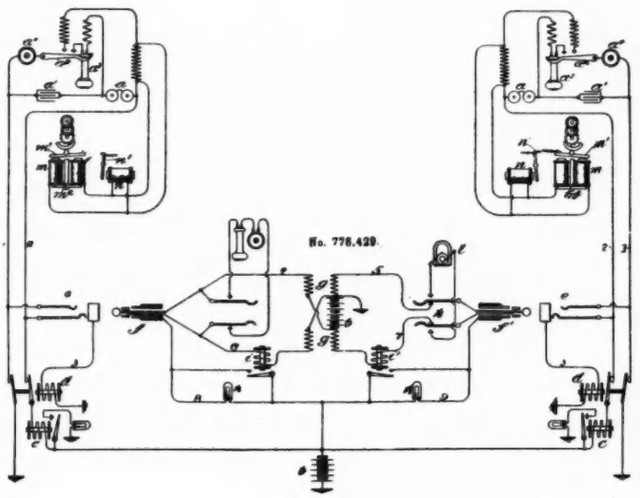
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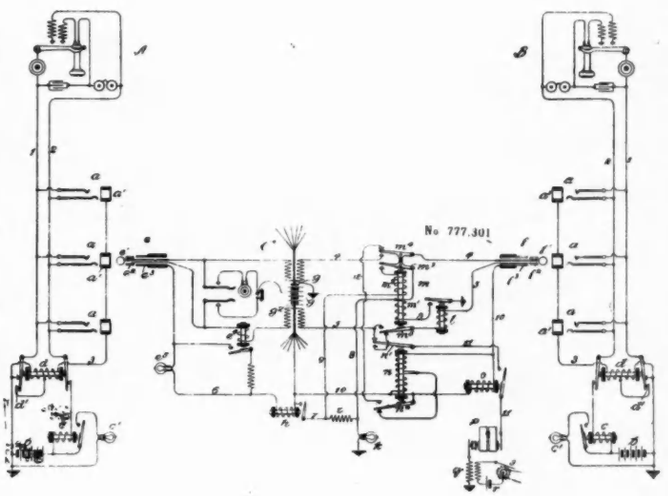
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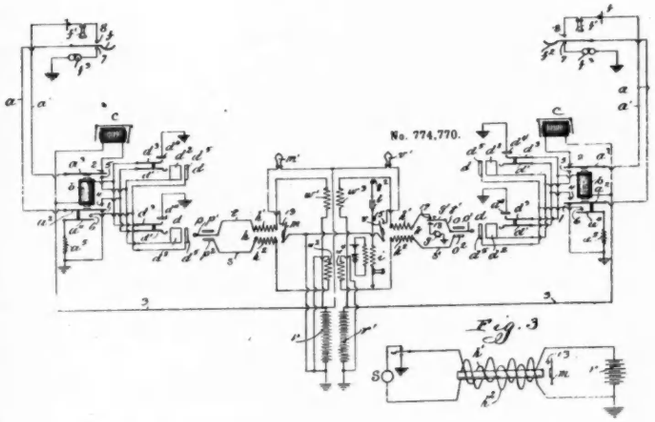
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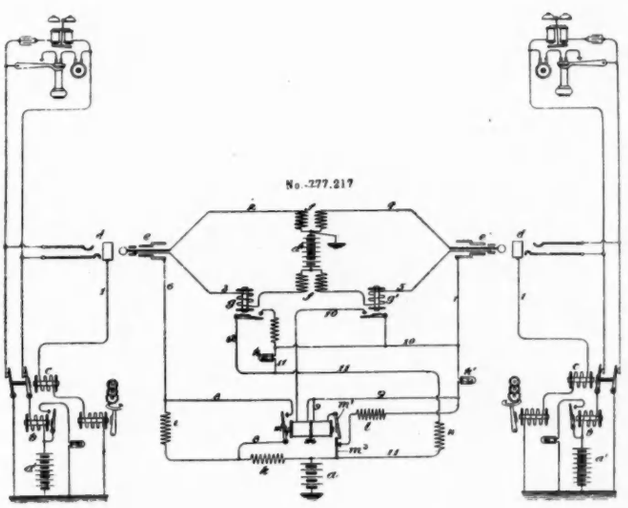
Fig. 3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relays therefor are shown. There is little or no originality in the case, the switch-hooks, relays and other apparatus shown are out of date, with rubbing contacts instead of platinum points, and generally the scheme is not in accord with American practice.

776,112—S. Churchill-Otton. Sanitary Rotating Diaphragm for Telephone.

This gentleman hails from East Melbourne, Victoria, Australia. His invention comprises the usual little metal frame clamped on to the mouthpiece of the transmitter and containing a roll of paper which is fed through slots in the frame across the mouthpiece, so you can pull it and get a clean piece any time.

776,218—F. B. Cook. Self-Soldering Heat Coil.

The various gentlemen in the protector business are certainly evolving all possible variations of the self-soldering heat coil idea. The star wheel soldered in a fork in one end of the coil is not new, but a purely rotary element, such as we noted in our last number, apparently originated with Mr. Cook. He took a piece of graphite and cut teeth around it, plated the ends and soldered it in a support. The present is a more highly developed embodiment of the same idea. Here we have a spool with a spindle *d* soldered inside of it. The protruding end of this spindle is squared to form a shoulder *c*. Around the outside of the coil is a toothed metal ring *b*.

The device is placed in position by sliding the squared shoulder into a slot in one of two bearing plates, the other one of which takes against the other end of the coil. The line spring is then caught up on the teeth of the sleeve, whereupon the latter tends to turn upon its spindle, but will not do so unless the solder melts, and then the device will be ready for another operation as soon as the solder cools.

776,290—A. L. Brinckle. Device for Connecting and Disconnecting the Talking Circuits of Telephones.

This is a notched collar placed around the neck of the standard of a desk telephone and capable of being turned thereon to move its notch into or out of position over the switch-hook, to thereby unlock or lock the same.

776,413—F. R. McBerty. Switch-Key.

This is a four-party selective ringing key. In most of such devices there are four separate keys provided for connecting the generator in four different ways, and a separate or master key for ringing. The circuit connection through the separate has usually been in series, so that any key in connecting the generator forward would cut off the cord back. The result was to make a lot of contacts in the cord circuit to talk through.

In the present case the selective keys are all in parallel as to their cord connection, and a separate pair of spring contacts is mechanically connected to all of them for the purpose of opening the circuit when any of them is used. The connection as shown consists of a reciprocating rod underlying the key levers and the top plate, with a cross pin engaging each lever so that a movement of any lever to connect the generator for ringing its particular station will push along the rod and open a pair of contacts at the end. Instead of having a number of contacts to talk through, therefore, there is only the one pair. The patent belongs to the Western Electric Company.

776,429—C. E. Scribner. Service Meter for Telephone Lines.

This invention is addressed to preventing the operation of the service meter and the false registration of calls by currents of different character from that for which the register is designed, such as calling currents in the line. The meter has a main actuating magnet with a polarized armature *m'*, and a neutral locking magnet *n*, which locks the armature and prevents registration by ordinary calling current. The main battery is directly connected to the calling plug, but reversely connected to the answering plug. When the subscriber calls the registering armature *m'* is drawn over in spite of the locking magnet, and when the answering plug is inserted the reversal of current reverses the registering armature to count one. When the calling plug is inserted, however, the registering magnet of the called station will not be actuated, as it gets current of normal direction only; but if the called subscriber should take down his receiver while calling current is on the line, the actuating magnet might be operatively energized except for the locking magnet. The ringing current acting on this locking magnet through the telephone bridge throws its armature into vibration, whereby the catch is moved into the path of the registering armature at each pulsation. Being of lower impedance, the locking magnet gets more current than the actuating magnet, the latter being provided moreover with a copper sheet about its cores or other means for preventing quick magnetization. Hence the meter at the called station is locked and cannot work.

776,435—E. H. Smythe. Telephone Exchange System.

This, as well as the preceding patent, belongs to the Western Electric Company. The object of the invention is to permit an operator on a multiple switchboard who has a call for a busy line already connected at some other section to plug in without waiting for the line to become idle, the connection being thereafter completed automatically when the line again becomes free. Signals are provided for the calling line to indicate automatically that the called line is busy and also the instant it is free. The invention is especially applied to trunk lines to permit an incoming trunk operator, who has a trunk call to give that call precedence over ordinary calls and to take all the preliminary steps so that the connection may be completed the instant the called line becomes free.

The underlying principle of the system is this: The test rings of a busy line have their potential raised, and the trunk line may therefore be provided with a controlling magnet which will keep the trunk open as long as this raised potential exists. When the line becomes idle the potential falls, and the controlling magnet then completes the trunk connection. Based on this the following agencies are provided: The *A* operator, in trunking a call, gives her order over the instruction circuit to the *B* operator, who designates the trunk. The *A* operator's plug is then inserted, and if the *B* trunk plug is still in its seat lamp *q* lights, magnet *p* off batter *d*, magnet *q* pulling up on current over wire *11*. When trunk plug is picked up lamp *q* goes out, magnet *k* pulls down to cut off the operator and the plug sleeve, and test or controlling magnet *h* is left connected to the jack sleeve *b3* by way of wire *6*. As long as the potential of the sleeve is raised magnet *h* is energized, trunk wires *4-5* are disconnected by inert magnet *g*, and a busy buzz from *n* goes back to the *A* operator. The latter's supervisory lamp *o'* is shunted out, its relay *o* taking current over the path *5, 9, m*. When the line becomes idle, magnet *h* loses current, lets go its armature, and closes circuit *7* of magnet *g*, which pulls down, disconnects the buzzer, breaks the supervisory relay circuit *5-9*, and completes the trunk wires *4-5*. The *A* operator seeing her lamp *o'* light, rings over the trunk and supervises as usual. When the connection is finished and the *A* plugs are pulled, relay *p* lets go, and lamp *q* lights off battery *d*, current flowing by way of wire *8* and to ground at *r*, this giving the clearing out signal to the *A* operator.

775,408—L. A. Schmidt. Electrical Register and System Therefor.

Considerable advertising has appeared recently concerning a register for subscribers' stations which could be read from central without any inspector going around. This is it. The idea broadly is to have a simple form of cyclometer register punched up by the subscriber working a button or lever for each call, the movable disks of this register having connected with them toothed transmitting wheels whose positions correspond to those of the indicators. Central is provided with a receiving outfit which can be plugged into the line at any time, and then by the subscriber turning a crank the number of calls set up will be transmitted and registered. Units and thousands are not transmitted, the position of the hundreds and the tens disk only being required. Only two transmitting wheels are therefore required. Each has a separate contact lever cooperating with a fixed contact, and both of these are grounded at the substation. They are normally out of connection with the line, and are adapted to be thrown into connection therewith by a lever worked by the subscriber. Each contact works back and forth under a stiff center spring, and when thrown past center one way goes into service, but when thrown past center the other way goes out. The transmitting wheels have a number of short teeth corresponding to the numbers on the disks, and each has a long tooth corresponding to zero. When this long tooth is reached in the general revolution, it throws over the lever and stops the register at central. A notch and stop finger are provided on the train and on the operating lever respectively whereby the crank cannot be worked while the register lever is held down. Otherwise the numbers might be tampered with. The transmission of a reading is very rapid, inasmuch as the numbers go over both sides of the line and ground simultaneously.

775,637—W. Schutz. Telegraph Pole.

This is Herr Wilhelm Schutz, residing at Cassel, Germany His invention is a glass telegraph pole, moulded hollow, with strengthening ribs inside, footsteps cast on the outside, and hermetically sealed.

775,680—P. O. Pedersen. Resonance Relay.

This is a highly sensitive relay having low resistance and self induction, sensitive only to currents of certain character, and comprising a pair of oppositely arranged tuning forks and vibrators stretched between said forks and located in a magnetic field. The actual construction is as follows: A metal plate has a tuning fork mounted at each end so that the legs stick up like the posts of a four posted bed. The corresponding legs on the two sides are connected by wires, and the fork at one end has a pair of contacts secured to its two arms and closely approaching but not touching each other. Straddling the two wires in the middle, and supported by the plate, is a heavy permanent magnet, within whose field the wires rest. The wires are connected in the distant circuit, and the aforesaid contacts, which, by the way, are insulated from the fork, are connected in a local or sounder circuit. When currents of approximately the same period as the tuning forks come over the line and pass through the wires, they set the same into vibration by means of the magnetic reaction, and the forks then vibrating in unison, the local circuit is made by reason of the rapidly recurring contacts at its terminals.

The magnetic field being invariable and the direction of the current forces being stated as perpendicular to the lines of force of the field as well as to the current, the vibrator is affected by forces directly proportional to the current present.

776,524—F. A. Lundquist. Automatic Telephone Exchange.

The application for this patent was filed April 30, 1900, and there are twenty-seven claims which seem to be of very considerable importance. To go into the apparatus described, or in detail into the circuits, would serve no good purpose here, but everyone who is interested in automatic telephony and its development should read the patent carefully. The invention relates to the central office switching in an automatic system, and seems to be primary to the percentage trunking system. Claim 2 reads as follows:

"In an automatic telephone exchange, a series of groups of main switches, each switch of which is individual for a connected telephone, and a group of auxiliary switches for each group of main switches, said auxiliary switches being less in number than the main switches, and each auxiliary switch being common for connections from any main switch but common for connections to only the switches of the group to which it belongs, substantially as shown and specified."

For those who are not familiar with the system of trunking to which this refers, it may be stated that of course in its most primitive shape an automatic system would have to have a contact in each switch for every line in the exchange. In other words, for a one hundred line exchange there would have to be 100 switches, each with 100 contacts, or 10,000 contacts in all. Thus the number of contacts required would increase as the square of the number of lines, and would be prohibitive for a large exchange. All successful systems use some percentage system. A line switch is usually provided for each line, which is always controlled by its line, and through this switch the calling subscriber puts himself into connection with idle apparatus in the exchange by which his connection may be completed, to the line wanted. The individual line switches are usually called first selectors, and through these the subscriber in a large exchange connects himself to a switch representing the thousands digit desired, this being known as the second selector and being in turn used to select a switch corresponding to the hundreds digit and known as the connector, for by its operation in the next set the line wanted is finally picked out, tested, and connection made therewith. The subscribers' lines are multiplied to terminals in the connectors only, the trunk lines of the connectors are in turn multiplied to the second selectors only, and the trunk lines of the latter are multiplied to the first selectors or individual line switches. Usually there are duplicates or groups of switches at each step, and in going through for a selection an idle trunk and an idle switch are automatically selected. Claim 25 reads as follows:

"The combination with the stations of a telephone exchange, of a plurality of switches less in number than the number of stations in the exchange, and electrically operated means by which an automatically selected one of said switches may be used in establishing a talking circuit between two stations."

The switch mechanism illustrated is in substance the improved Strowger apparatus, most of its features being those made familiar by the Automatic Electric Company. There are nine sheets of drawings.

776,728—W. W. Dean. Attachment for Transmitters.

This is a card holder for a number card, clamped on the transmitter front by the mouthpiece. The patent belongs to the Kellogg company. The claims cover a light open frame to receive a number slip, provided with a ring at its inner end to receive the mouthpiece. There are a number of such devices, and the novelty in the case is extremely slight.

776,960—G. W. Tally. Telephone Transmitter.

The object here is to provide a diaphragm unaffected by moisture, heat or cold and without any sharp metallic rattle. The diaphragm proper is secured around the edge to a ring frame which carries a rear spider, and between the

spider and diaphragm lies the electrode chamber or cup filled with granular carbon resting against the diaphragm. The latter is built up of a layer of silk, linen, cotton or jute, coated with carbon, on this a second sheet of fabric, and on this a thin film of mica, glass, celluloid, or similar material, the outsides varnished.

777,172—H. G. Addie. Telephone Attachment.

The invention, if so it can be called, in this case, is a condenser in a box with binding posts on the outside and a flexible cord coming out through a hole in the side of the box. The condenser thus equipped is in handy shape to include in a circuit, presumably to cut over from magneto to common battery, although no circuits are shown.

777,216—S. Musits. Apparatus for Wireless Telephony.

This is a scheme for transmitting through the earth. It includes microphones in the primary circuit, a secondary circuit with the receiver as usual, this being connected to cylindrical bodies of copper buried in the ground, which may be filled with an electrolyte. Keys are provided for sending impulses to call. The patentee is an official of the Royal Hungarian Postal and Telegraphic Administration.

777,217—F. R. McBerty. Telephone Service Meter.

This is a meter system wherein the meter has its magnet connected in series with the cut-off relay magnet of its line at the central office, the switchboard circuit being of the well known Bell relay type, common battery. The scheme is an improvement on that shown in reissue patent No. 12,185, granted December 22, 1903, to McBerty, both of course being assigned to the Western Electric Company. A self-locking relay is provided connected with the supervisory circuits so that the meter of the calling line will not be worked until the called subscriber has answered. In some cases, where a subscriber makes several calls in quick succession, the answering plug is left in, and heretofore his register would not work for all such calls. In the present case the current required for the cut-off relay is less than that required for the register. Cut off current is supplied through a resistance to each connected jack and cut-off when a pair of plugs are in, but the relay *m* does not pull up until the called subscriber answers, when this relay pulls up to shunt resistance in branch to the calling jack, the increased current working the calling subscriber's register, and the locking relay *m* holding its own circuit closed until the calling plug is pulled up, when it lets go, and if another connection is then made with said plug, and the subscriber answers, the calling subscriber's register will again work.

777,301—J. L. McQuarrie. Busy Signals for Telephone Exchanges.

This is a scheme somewhat similar to that already described above, whereby an operator need not wait to test a line to see if it is busy, but can plug in, and if it is busy the connection will remain broken and a busy signal will go back to the calling subscriber. A combination of relays is employed to open and close the cord, and a busy back relay connected to the sleeve of the calling plug so that if the potential of the jack thimble is raised the cord will remain disconnected, and the busy generator sends current back through the repeating coil to produce a characteristic sound in the calling subscriber's ear. It is stated that since in an average exchange only about ten per cent of the calls have to be abandoned because the line is busy, the removal of the necessity for a test of the other ninety per cent will greatly facilitate the operation.

777,310—W. H. Rose. Telephone Disinfecting Device.

This is a cap fitting over the mouthpiece and having an inturned flange resting against the front plate of the transmitter so that it will hold a liquid disinfectant. A fabric is stretched inside the cap, protected by a wire screen, and clamps hold the device on to the body of the transmitter.

777,324—C. Adams-Randall. Telephone System.

This is a scheme for transmitting over cables and circuits having a high static capacity. The patentee says: "By means of my present invention, I have transmitted articulate speech over iron wire circuits, and over artificial cables of capacity and resistance up to a K. R. of 5,985,000." An important feature of the invention consists in leaving the line circuit open at one end, or at both ends, the circuit being normally or artificially provided with the proper resistance and capacity, with a suitable impedance inserted in the circuit between the transmitter and ground and the latter disconnected from the ground. The main features of the apparatus are stated to be, a transmitter capable of carrying a heavy current, one or more induction coils suitably wound, a compound wound coil having three or more independent coils, and a shunt around the receiver directly to ground and including an impedance or resistance.

777,429—W. Parker. Party Line Telephone System.

This is a many party line having one side of the circuit continuous and the other side cut in lengths from station to station with up and down contacts for the switch-hook at each station, the line being continuous through each when the hook is down, and the ringer bridged. The hook has a lever mechanism controlling a step-by-step switch or commutator so that as the hook is moved up and down it steps around the switch and this in conjunction with the hook contacts cuts off the line one way or the other.

777,525—G. A. Long. Telephone Toll Apparatus.

This patent is assigned to the Gray Telephone Pay-Station Company, of Hartford, Connecticut. A guide board is provided having channels for the different coins, with bells or gongs to be struck as the coins fall. At the bottom of each channel is a trap consisting of a slot of inverted V-shape so that if a string is tied to a coin, after the coin has fallen its limit the string will catch in the slot and the coin cannot be pulled out.

777,544—J. G. Roberts. Telephone System.

This patent is assigned to the Kellogg company, and covers what is commonly known as the four-relay cord circuit. Claim 1 reads as follows:

"In a telephone system, the combination with a telephone line, of a source of current and a relay bridged between the two limbs of the talking circuit thereof, a second relay and means for energizing it, a switch at the substation and a switch at the central station for controlling the circuit through said relays, and a signal controlled by the conjoint action of said relays, substantially as described."

In the diagram *A* is the bridged battery, and *r-r'* are the bridged relays controlling the supervisory signal *S'*. One relay takes current when the plug is in, and the other relay responds to current in the line.

777,583—H. Baethig. Sanitary Attachment for Telephone Transmitters.

This is a wire frame with a sheet metal back *C*, the latter clamped over the transmitter by a ring fitting under the mouthpiece, thin sanitary sheets mounted on the back and adapted to be pulled down over the wires *F* one by one to cover the outside of the mouthpiece.

777,607—A. B. Cruickshank. Mouthpiece for Telephone Transmitters.

This is a ring clamped on the edge of the mouthpiece and hollow, having a soaked absorbent material in it, with openings around its inside face. The ring is clamped on the mouthpiece by spring fingers.

A Trouble Testing Circuit

ARTHUR KNEISEL

GREAT numbers of circuits have been devised for testing telephone lines, but as trouble testing is an important factor in exchange work, new ones are always more or less welcome. It would be impossible to give any set rule for the building up of such a circuit, as it depends greatly upon local conditions, such as types of apparatus used, as well as upon the line and cord circuits of the exchange.

Tests are made for open circuits, short circuits or crosses and grounds, or combinations of these, and can be made fairly well with a voltmeter, but with greater accuracy with a Wheatstone bridge. Occasionally a wire chief can tell much about a line in trouble by listening to the induction on it. In small exchanges an extra telephone near the distributing board usually serves the purpose of a test set, but in large exchanges where there are many trouble men, and rapid tests are essential, something more elaborate is called for.

A circuit, the using of which does away with removing the coils from the line, is comparatively easy to set up and operate. Fig. 1 is a diagram of a circuit for trunking lines in trouble to the wire chief's desk, and Fig. 2 is a diagram of the testing circuit proper with the wire chief's telephone, transmitter and order wire buttons.

In Fig. 1 *A* is a three conductor cord having its sleeve crossed with the trouble tone *O*. Tis is placed at a *B* board, operator's section, or if there is no *B* board it is put on the last section of the *A* board. *B* is a line relay. *C* is the cut off relay. *D* and *E* are the jack and lamp signal for the trunk placed on the wire chief's desk. There may be as many of these trunks as the work of the exchange may demand. Under ordinary conditions, twenty will be sufficient for a 5,000-line board. In case of so many trunks, it is an advantage to distribute the cords about the board, one at least at the turning section and one at the end of both the *A* and *B* boards, as this will permit tests to be made for opens in the multiple each way.

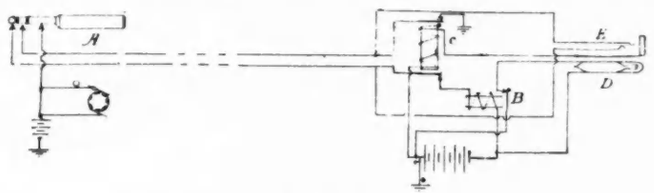

FIG. 1.

In Fig. 2 *A'* is a three conductor cord wired to the mainsprings of the two way key *B'*. One end of this key is connected through a battery to a voltmeter *v*. *H* is a two point switch by means of which either side of this circuit may be grounded. The other end of the key *B* is connected to the *X* building posts of a Wheatstone bridge.

C' is another two way key having the primary of the induction coil and transmitter for the wire chief's talking circuit on one end and the generator *G* with the low wound ringer *R* in series on the other end. The secondary of the induction coil, besides being wired to the telephone jack, is also wired to two common bars from which taps run to the main springs of the order wire buttons *F' F''*. The outer contacts of these are taps from the secondaries of the inductions coils of operators who have the cords *A* of Fig. 1.

To test a line, the wire chief pushes one of the buttons *F' F''* and orders "put up No. — for trouble." The operator mentions the number of the trunk and inserts that cord into the multiple of the line called for. If the line is "permanent" or "steady light" on the switchboard this will clear it there by operating its cut off relay, and cause it to show permanent on the wire chief's desk. Plugging up this connection also puts the trouble tone on the sleeve of the line being tested, thereby notifying any operator, who may make a busy test, that the line is in trouble. This is a decided advantage as it prevents unnecessary ringing and allows the monitor a possible chance of getting the party in case of urgent need.

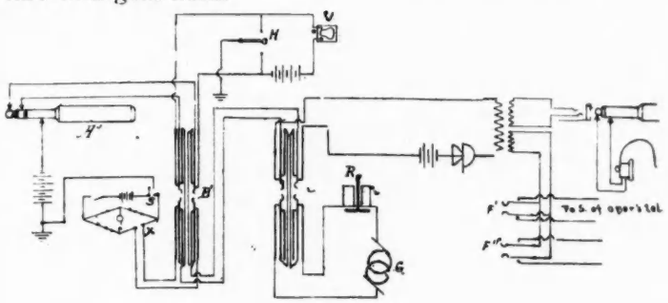

FIG. 2.

After the operator has assigned the trunk, the wire chief begins his test by inserting the plug *A'* into the jack *E* of that trunk. The battery on the sleeve of this plug will operate the cut off relay *C* and continue the line straight through to the key. By throwing this key to bring the voltmeter into play a short circuit can be measured directly. If there is no short test for ground on either side of the line it can be made by grounding one side of the volunteer circuit at a time by means of the switch *H*.

In testing with the voltmeter it is necessary to know its resistance and to have the voltage of its battery to give a maximum reading; that is, if the voltmeter reads to 100, have a battery of 100 volts.

If E = voltage of the battery, it also is the deflection on a solid short.

Let R = Resistance of voltmeter.

X = Resistance necessary to give a deflection D, i. e., the resistance to be found.

D = Deflection observed.

$E-D$ = Difference between whole deflection and new deflection.

On a solid short circuit $C-\frac{E}{R}$ gives a deflection E. A deflection of division on voltmeter $= \left(C=\frac{I}{E}\times\frac{E}{R}\right)=\frac{I}{R}$

$$C^1 \text{ for a deflection } D = C^1 = \frac{D}{R}$$

$$\frac{D}{R}=\frac{E}{R+X}$$

$$D\,R + D\,X = R\,E$$

$$X \times = \frac{R\,(E-D)}{D}$$

To measure the resistance of the line with the Wheatstone bridge it is only necessary to throw the key *B* in the opposite direction from the voltmeter end and proceed in the usual manner. In making a Varley loop test with the Wheatstone bridge it is necessary to have another two-point switch *S*, so that one side of the battery may be opened and grounded.

A test for open is made by setting the key *B* to normal

and ringing out with the key *C*. If the line is closed the ringer *R* will operate. The key *C* in listening position will enable the wire chief to talk to the subscriber if necessary.

After a line has been cleared of its trouble it is restored to normal condition by the wire chief pressing the proper order wire button and requesting that trunk No. — be taken down.

One great advantage of this method of testing is that a line can be watched very closely and ordered down immediately after it has been cleared. With this system another plan is feasible. When a line is reported permanent, a supervisor plugs it up on a trunk and mentions the number of the trunk on the memorandum she sends the wire chief.

UNDERGROUND CONSTRUCTION.

The city authorities of Dayton, Ohio, have ordered all telephone wires placed underground.

At an expense of $20,000 a conduit system for telephone wires is being constructed at Waterloo, Iowa.

The Washtenaw Home Telephone Company is laying its wires underground at Ypsilanti, Michigan.

Telephone wires in the business portion of Oakland, California, are being put underground as rapidly as possible.

The city of Peoria, Illinois, is considering placing its fire alarm and police wires underground.

The Mexican Telephone Company will install an underground conduit system in the City of Mexico.

The underground telephone conduit system in Savannah, Georgia, is being extended.

A conduit system for telephone and telegraph wires will be laid at Geneva, New York.

The Paris (Tenn.) Telephone Company will construct a new telephone system, placing all the wires underground.

Work has been commenced at Green Bay, Wisconsin, on the conduit system to be installed by the Valley Telephone and Telegraph Company, which was recently granted a franchise there in opposition to the Bell.

An ordinance has been passed at Greensboro, North Carolina, requiring that all telephone wires be placed underground.

The El Paso Telephone Company will construct about twelve blocks of underground cable system in Colorado City, Colorado.

The Inter-State Telephone Company has been granted a franchise to construct an underground system in Auburn, Illinois.

Telephone service in Northampton, Massachusetts, will be vastly improved within the next few months by the adoption of the underground conduits.

The South Bend (Ind.) Home Telephone Company contemplates installing an underground system in Niles, Michigan.

The police department of Cleveland, Ohio, has received $10,000 worth of new telephone and telegraph cable that is to be used in enlarging the department's system of underground connections.

D. M. Neill, who has been granted a franchise for an exchange at Red Wing, Minnesota, has received material for the conduit work, which will be rushed to completion as rapidly as possible.

The Marshalltown (Iowa) Telephone Company has commenced the installation of an additional cable of 400 wires which will be placed underground to accommodate the rapid growth of business in that city.

The city council of Los Angeles, California, is making arrangements to have the underground telephone and telegraph wire districts enlarged and to see that the companies put their wires underground.

All electric, telephone and telegraph wires in Grand Rapids, Michigan, must be placed underground in the conduit district by July 1, 1905, and a general extension of the conduit system is proposed.

An ordinance has been introduced at Watertown, New York, providing that after October 1, 1905, no telephone, telegraph or electric light wires shall be above ground in certain parts of the city.

The city council at Little Rock, Arkansas, has decided that telephone wires in the business part of the city must be placed underground.

The Inter-State Telephone Company has a force of men at work at Springfield, Illinois, laying an underground 200-wire cable from the office on Monroe street, east on Capitol avenue to Eleventh street, thence south to South Grand avenue. The new connection will accommodate the increased business south of the avenue.

USE OF TELEPHONE IN LOGGING OPERATIONS.

Throughout the forests from the St. Johns to Vancouver lumber camps belonging to the same interests are connected by telephone, the lines running thence to the sawmills or wood pulp mills at frontier towns, from which communication can be had even with the metropolis.

It was formerly the custom for each lumber interest to maintain couriers, like the voyageurs of the Hudson Bay Company. These hardy men, with knapsack, would travel twenty-five miles a day through the wilderness over rough forest paths. Now the mill calls up each camp in turn at stated hours, receives reports and gives instructions to the foreman. Letters are read to men snowed up in the forest fifty or a hundred miles away and answers are dictated by the lumbermen to a stenographer, who transcribes them in the office and then mails them to their homes.

The application of the telephone to the operations of logging are alike useful. The lines are run upon trees along the banks of rivers, and telephones in sheltering boxes are attached to trees and connected to the line. The peril of logging is the massing of the logs together at some narrow place in a turbulent stream and piling upon each other in a "jam," to which a contribution is made by every log floating down the river. The formation of a jam results from some obstacle and generally comes without warning. It requires great labor, fraught with peril, to move the logs from their position. It is frequently necessary to use dynamite, and much lumber is destroyed by such explosions.

With the use of the telephone warning of the formation of a jam can be given by one of the men patrolling the banks, who telephones to men up the river to stop the flow of logs at calm places, termed "trips." It is an easy matter to break a small jam. Assistance can be obtained by summoning men from points lower down the stream. As soon as the small jam is removed the men above are told through the telephone to release the logs at the "trip," and the stream of logs is resumed.

Under former conditions a larger number of men were employed, and when a jam was begun it was necessary to send messengers one to three miles through the forest to direct the gangs to stop the flow of logs and to summon help from down the stream. Then after the jam had been broken second messengers must be sent up the stream to release the logs at the "trip."

By the promptness of telephonic communication the rate of sending logs down the stream is increased by the avoidance of delays. Beyond this the use of the telephone renders log-driving feasible on the smaller rapid, rough streams, where it was formerly out of the question.

In 1903 nearly 365,000,000 telegraphic messages were sent in all countries, while in 1902 the number of telephone messages transmitted in the United States alone was more than 5,000,000,000.

DIGEST OF TELEPHONE LITERATURE

Conducted by Samuel G. McMeen.

Independent Financial Reports—Telephone Journal, December 10.

FINANCIAL AND ECONOMIC.

For a long time the Bell company remained in reasonably blissful ignorance of the existence of Independent enterprises, but for reasons which need no comment, an awakening has been experienced. A more or less systematic and successful Bell educational policy is now in pursuance, the object being the informing of certain parts of the public with reference to the "danger of Independent telephone securities." That there is such a danger will be admitted by all, but by most it is understood to be a danger from which the Bell company only has suffered and is suffering. A duty which lies upon every fair-minded Independent telephone person is to know what is being done in the way of success by those companies, which are deserving and receiving success. There are many such, and the reports of two of them are contained in this article.

The Telephone in Australia—HESKETH.—*Telephone Journal, December 3.*

An interview with John Hesketh, electrical engineer for the state of Queensland, Australia. This is the Mr. Hesketh who came to America to attend the International Electrical Congress, and who read there his notable paper on the beetles which he has found are destroying the efficiency of cables by boring holes in the lead sheaths. His remarks deal with the organization of the telephone service under government control, and with the rates which are charged for telephone service. In the larger cities the rate for individual line service is only $45 per year, but this is based on the desire to make no profit and on a purchasing value of money considerably lower than that which exists in the United States. Party line service is not yet developed as here, and the adoption of common battery equipment is yet to come. In the largest centers the development of the telephone is between two and three per cent of the population.

Depreciation of Telephone Plants—Finance, December 10.

There has been much discussion among all persons interested in telephony, as to the right values to be assigned to the depreciation of the various parts of a telephone system. This item quotes an interview with Col. F. S. Dickson of Cleveland, Ohio. His opinion is that there has been a tendency to overestimate the amount which ought to be charged off for depreciation, and he cites the conduit system as an example of material which increases rather than decreases its value as time passes.

Telephone versus Telegraph—Finance, December 10.

Statistics seem to show that the use of the telegraph is not extending, or, if so, at a very minor rate in comparison with the use of the telephone. In Great Britain last year the number of telegrams diminished. The social life of people living in the country has been remarkably affected by the extension of the telephone, and in this article the interesting fact is cited of the extensive use of rural lines in connection with the late election of a governor in Missouri.

Independent Dividends—Finance, December 10.

An interesting item containing comment of a general character upon Independent telephone finance. The greatest truth contained in it is that dividends should be paid if earned, and that with such a principle in application there will be a minimum of difficulty in securing, by loan or otherwise, new capital for necessary extensions of the enterprise. It is a healthy sign of the times that more and more tendency toward expressions of this kind is in evidence.

Cost of Telephone Service in Farming Communities—SPRAGUE.—*Electrical World and Engineer, December 10.*

With a view to determining the actual cost of giving telephone service to subscribers scattered over a considerable territory, a special investigation was undertaken, and this article describes it in detail. Three tables indicate that the cost of the equipment per station was $11.72, or including the central office apparatus as well, $77.60. The lines cost an additional sum, enough to make the total cost $143 per station. The revenue is shown to be $30.40 per station per year, and the cost of giving the service $30.80. While no conclusion is drawn and stated, the whole tenor of the article is discouraging, and if the instance were well selected and the test honestly made, somebody is losing money.

A Growing Independent System—DWIGHT.—*Telephony, December.*

An illustrated description of the Independent exchange at Kenosha, Wisconsin. An interesting feature of the equipment is that the operators work upon a multiple board of the flat-top type in which the plugs are inserted downward into jacks, instead of horizontally as is usual. The board is illustrated in a photograph. The article contains also certain interesting information concerning the plant at Racine, Wisconsin, and some financial data concerning the company which operates that system.

Testing Equipment of a Common Battery Central Office—O'BRIEN.—*American Electrician, December.*

EQUIPMENT.

In common battery systems line insulation is of the utmost importance. A magneto system may operate with poor lines, although it should not be called upon to do so, but a common battery system will refuse. A drawing illustrates the circuits adapted for use with a voltmeter and a battery to enable a wide variety of tests to be made. Sixteen keys are involved in the arrangement shown, and these, with convenient circuits adapting any line to be taken up for test, enable opens, crosses, grounds, short-circuits and similar difficulties to be investigated. Although the equipment does not include a Wheatstone bridge, much can be done in the way of locating grounds or crosses, and with a speed far exceeding methods involving bridges and rheostat adjustments. A well-equipped wire chief's desk should contain filing cases or drawers for card records of the lines entering the central office.

Telephone on Warships—GRADENWITZ.—*Telephone Journal, November 26.*

Old-fashoined speaking tubes are being supplanted on board ships by telephones, but these are required to be specially adapted to the surroundings in which they must be placed. Current for the operation of the instruments in the described system is taken from the direct current supply circuits used for lighting the ships and for operating machinery. Special precaution is taken to exclude moisture and extraneous noises, and the instruments are made on lines adapting them to speak very loudly. A striking element of construction is that of stability.

Commercial Aspects of Telephone Line Protection—MILLER.—*Electrical Review, Dec. 10.*

There are three things against which telephone apparatus must be protected: lightning, high tension currents, and small currents. Carbon block arresters protect against lightning damage, and co-operate with fuses in protecting

against damage from currents of reasonably high potential. Heat coils, co-operating with fuses, protect against damage from small currents likely to develop heat enough to cause injury. The article contains dimensional information of distinct value, and a clear resolution of the important question as to where the fuses shall be placed. A deduction distinguishing between the theoretically proper and the economically wise arrangement of fuses makes this a welcome contribution.

Adams-Randall Transmitter—WILDER.—*Sound Waves, December.*

A description of a transmitter having a plurality of carbon buttons, each having its own portion of an induction coil circuit and its own source of current supply. A map describes the circuit over which some tests were made, and it is stated that very loud transmission was secured, because of the considerable energy put in by the plurality of batteries.

A Novel Substation Set Circuit—BEYLAND.—*Sound Waves, December.*

A description of a receiver and transmitter circuit for use in connection with common battery lines, and which involves elements distinctly unusual in existing practice. Three circuits in common use are compared with the one under description. One involves an induction coil and condenser; another an induction coil with no condenser, and the third an impedance coil and a condenser, while the particular type under description is of the form of a Wheatstone bridge, using the receiver as the bridge across the lozenge, two opposite arms being impedances and the other two non-inductive resistances. The whole combination is interesting, is doubtless highly effective, and impresses one as being amazingly direct in accomplishing what it sets out to do.

Party Line Systems—WINSTON.—*Sound Waves, December.*

The systems described in this article are all adapted for use with common battery central office equipments, two of them being systems used by the Bell company, one being the Dean system and another the Leich system; the simpler of the two Bell systems is that having four stations, the ringers of two of them being legged to ground from one side and the ringers of the other two from the other side of the line. This puts a ground on each wire outside of the central office, although the resistance of each ringer may be very high. To avoid this, the other system has been devised, in which each station has a relay bridged across the line in series with a condenser, and it is the object of this relay to connect two ringers to the wire rung upon, only at the time of ringing. Selection between the two ringers thus connected is accomplished by having one of them respond to positive and the other to negative pulsations. In the drawing which Mr. Winston gives, two of the ringers are shown connected directly to one of the wires, but probably this is inadvertence. The Dean system depends upon different frequencies of ringing current and is distinctly better than either of the Bell systems, for the reason that there is nothing involved in the sub-station equipment except a firm, reliable ringer in series with a condenser, so far as the signal receiving device is concerned. On the same plan, the Leich system depends for its selection on relative frequencies and in that case also a condenser is in series with each ringer. The ringers are bridged to ground and are either in series with an impedance coil and the condenser, or are shunted by an impedance coil as well as being in series with a condenser.

The Accumulator in Telephone Work—HIGGINS.—*Sound Waves, December.*

Apparently the first article of a series. The general characteristics of sulphuric-acid-and-lead storage batteries are described, together with useful information as to setting up cells, giving the first charge, maintaining the voltage and operating the installation regularly. The article contains a table of the dimensions, capacities, and rates of charge and discharge of storage batteries from 9 to 27 plates 11x11". Drawings illustrate the method of charging small batteries from direct current lighting circuits, and special instructions with reference to testing and troubles conclude the installment.

The Telephone—TAYLOR.—*Sound Waves, December.*

The eleventh article of a series, and treats of switchboard circuits and apparatus. The reasons for the existence of a tubular shell over a magneto drop are illustrated and described and a diagram illustrates the straying of magnetic lines of force in cases where cross talk can exist. The reasons why it is of advantage to cut off both sides of the line in the spring jack of a magneto system are two: one of them is to remove the likelihood of unbalancing the line should there be a low insulation in the drop, and the other is the likelihood of less trouble from lightning if there be no common ground close to the core.

Telephone Extension Circuits—CLAUSEN.—*Sound Waves, December.*

Apparently the first of a series, and contains eight drawings illustrating extension circuits, by which is meant circuits adapted to carry several telephones, one of which may receive a call and any one of which may make one, one end of the circuit quite usually terminating in a central office. There are many phases of such systems, and in his description the author states the requirements to be met by each case. All of the circuits illustrated in this article are those adapted to be used with central office and substation equipments of the Bell type, although by slight modifications they could be adapted to any other standard common battery system.

Private Branch Exchanges—O'BRIEN.—*Telephone Journal, December 10.*

The fifth article of a series on the "private branch exchange as a business builder," and deals with the physical character of private branch exchange switchboards. The article illustrates two forms of cord circuits and a switch adapting a trunk line from the main central office to be connected to a local storage battery during the hours in which the private branch exchange is out of use. By a similar connection in the central office, the local storage batteries may be charged. In other forms of installation, these small storage batteries are kept charged by special pairs of wires connecting them with the main storage battery in the central office. The number of pairs necessary for this purpose in any given case will depend upon the size of the conductor, the distance from the central office and the voltage which it is necessary to maintain at the terminals of the local storage battery. In some other systems the local storage battery is not used, but the pairs from the central office supply the current directly to the local lines and cord circuits in such amount as the number of calls and connections shall require. The resistance of the leads to the central office being really an appreciable amount, it is necessary to bridge a considerable capacity in condensers across these wires at the private branch exchange.

Principles of Power Equipment for Telephone Exchanges—WILLIS.—*World and Engineer, December 17.*

The essential elements of the telephone power plant are the storage battery, the means of charging the storage battery, the devices for ringing and other signals, controlling equipment, and the wires and conduits for the distribution of the power plant energy. These elements are treated in detail in the article. To determine the size of the cells and their number, certain calculations are necessary, and these are indicated. A certain relation is necessary between the storage battery and the charging equipment. The writer advises us relative to charging by means of machines, and charging direct from commercial power circuits. It is evident that the latter method is more easily accomplished with economy, if the voltage of the storage is high. Three types of ringing machines are described, these consisting of a motor and generator direct connected or connected by a

belt, or having both elements in one armature between one pair of fields. Selective signal currents of varying frequencies or polarities are necessary in some systems, as also are busy back and other audible signals in most systems. The author does not mention means of producing ringing current from batteries by means of pole changers. The power board and the conduit system are described in some detail.

A Home Made Pole Changer—RICHE.—*Telephone Journal, December 17.*

Construction details of a pole changer designed to be made of simple materials, in a simple manner, the estimated cost of the device being less than $5.

Hints on Rural Construction—PRICE.—*Telephone Journal, November 26.*

The second installment of a series dealing with the details of pole setting and right of way matters. Under all circumstances it is advisable to select the poles with respect to the contour of the country, so that the level of the wires may be reasonably uniform without abrupt changes in height, whatever may be the rising and falling of the surface of the other under the line.

LINES AND LINE CONSTRUCTION.

Use of Surplus Facilities—ABBOTT.—*Telephone Journal, December 3.*

The wire plant of a telephone system can be but partially utilized at the best. In its underground portion the expense per unit of duct is greater when the number of ducts is small. One of the ways by which the cost of the wire plant may be kept down is by combining it, both in the underground and aerial portion, with other systems of wires which need to be carried along the same routes. A photograph shows three poles belonging to three different systems standing within a few feet of each other. Another photograph shows one pole carrying all the wires of the three systems. There is little doubt which is the cheaper and more sightly method. It is also true that a single subway may carry with safety and economy, power, lighting and other electric circuits. Not many years ago there was a wide variety of reasons why all the heavy current-carrying systems needed to be kept away from the wires of systems connected to apparatus easily destroyed by heavy currents. Very largely these reasons have disappeared, and the tendency is and ought to be in the direction of enabling the various systems to be carried as a unit wherever the interests of economy and public convenience shall make the combination desirable. To occupy the same conduit is really very little different from placing the conduit lines of several kinds of electric systems side by side. An examination of cross section of many streets of many cities will show all kinds of conduits separately laid, but really forming one structure.

Underground Construction for Small Exchanges—Western Electrician, December 10.

A short description of the construction and equipment of the Wayne, Nebraska, exchange.

Thawing Out Cables by Electricity—Electrical World and Engineer, December 10.

Telephone cables in the ground in Chicago have been injured rather extensively during the past several winters by the freezing of water around the cable in the iron pipe leading to a lateral pole. At first it was supposed that the cables were damaged in every case; because, when taken out, they were found to be badly flattened or crushed. The trouble made itself known by short-circuiting of pairs in the cable. If the freezing was allowed to go on after the first trouble made itself manifest, more and more pairs would be put out of service by the pressure. In the beginning, a steam fire engine was hired at $5 an hour to blow in steam and melt out the cable. Later, a plan suggested by R. S. Pierce and worked out and applied in detail by J. M. Humiston, enabled the ice to be thawed out and the cables restored to good condition at small expense. In most cases it is not necessary to pull out the piece and put in a new one, as the thawing of the ice relieves the pressure on the cable enough to clear the cross between the wires. The apparatus consists of a wagon with transformers capable of reducing the 2,080 voltage of the alternating current supply of the city to 115 volts. Current up to 700 amperes can be passed through the cable sheath or the iron pipe containing it, and it is usually a matter of little difficulty to thaw out even a serious case.

Locating Faults in Electric Cables—FISHER.—*World and Engineer, December 17.*

In some measure this article bears upon power cables more than telephone circuits, but in principle all that is told applies to electric conductors in general. The illustrations are exceedingly good, and the authorship is a guarantee of accuracy, as Mr. Fisher is an authority in these directions. The fault location methods are those depending upon the systems of Murray and Varley, and the drawings are quite the best which have yet appeared on such subjects.

A New Danger to Telephone Lines—KELSEY.—*Electrical Review, December 17.*

The danger referred to is that of the considerable extension of alternating power circuits of high potential. These operate to make noisy the telephone circuits which are carried near them, and in addition such potentials may be caused upon the telephone lines, as to make the latter really dangerous to touch. Ralph Mershon and Paul Lincoln have made some study of the mutual relations of such circuits, and the conclusions which they have reached are analyzed by Mr. Kelsey in this article. It is to be hoped that the danger is overdrawn, but in any case this new problem is one which requires careful investigation, and this contribution should be found of great value. It is quite impossible to condense its usefulness into a single paragraph.

A Spare Pair Record—MCMANN.—*Telephone Journal, December 17.*

A description with an illustration of a cable record, in which the route of a wire is shown by horizontal lines drawn through the ruled spaces. One use of a record is to enable information to be obtained concerning the number of overlapping pairs between two or more terminals, and the information is graphic.

A Practical Way to Turn a Corner—ELGES.—*Telephone Journal, December 17.*

A description of three ways, with three drawings, of turning an aerial open wire pole line at a right angle. One involves a corner pole with cross arms at 45 degrees to the wire; another two poles at the corner, their arms being 90 degrees with each other, and the third, said to be the best way, involving cross arms in a single corner pole, these arms being at right angles to each other. The wires on the inside of the corner thus cross over each other.

A Study in Traffic—Telephone Journal, December 10.

Very naturally, when you come to think of it, the simplest way to decide questions of telephone traffic is to determine how much of it is to be handled, the possible capacity of the various elements for handling it, the varying efficiencies of these elements, and from these to arrive at a desirable, economical efficiency of the whole arrangement. It is easy to avoid knowing or to deceive one's self concerning the amount of traffic desired to be handled, and this article and others like it assist one to determine the amount and character of the work to be done. The article contains tables of elements which need to be determined concerning the circuits, the stations, the originating traffic, the trunk traffic, the elements of labor and particular features with reference to flat rate, message rate and party line service. Mention is made of the fact that a carefully conducted peg count does not reduce the efficiency of the operating force while the count is in progress. This has not always been the case and is not usually true where peg counts are not made at frequent intervals. This is something on the order of the complaint of the boy who would not comb his hair oftener than once a month, because it hurt so badly when he did it.

TRAFFIC AND OPERATING.

A Study in Traffic—Telephone Journal, December 17.

A continuation of the foregoing, and contains four sets of curves showing variations in daily traffic in several offices. The first of these compares, in a striking manner, the traffic of a day in three offices, one being in the business center, one in a residence district, and the other in the outskirts of the city. Nothing illustrates the range of variation in social activity in a large community better than such pictures as these.

Furnishing Election Returns—OGDEN.—*Telephone Journal, December 10.*

Furnishing election returns to subscribers has become a very important branch of local exchange business, whether or not a special revenue may be taken immediately for the service. The problem is two-fold, and consists in the careful, lively and accurate collection of the facts, then making this into bulletins which shall be distributed in an orderly and decisive way to the patrons. This article describes how some of these things were done in Philadelphia by co-operation between the Independent company and a newspaper.

Operating Trains by Telephone—SMYTHE.—*Telephony, December.*

Many railroads in America have made large investments in private telephone lines, three notable examples being the expensive circuits of the New York Central, the Lake Shore and the Illinois Central railways. The joint system of the New York Central and Lake Shore roads is said to have cost more than $200,000. It was formerly the universal opinion among railroad men that the telephone could never be used with safety in train dispatching. Whatever may be the final conclusion on this subject, much value is now being gained by minor use of the telephone in what may be called dispatching in large railroad yards. It has been found that the telephone is exceedingly more valuable than the telegraph in reporting details of special emergencies. such as wrecks and blockades. In addition many trains are equipped with telephones so that they may be connected with the exchange system of any city in which they make a stop rendering it worth while. It is likely that interurban electric roads, which are beginning to use the telephone for dispatching, will perfect the system enough so that steam roads may adopt it, or at least when they become electric roads.

Organization of a Central Office—O'BRIEN.—*Telephony, December.*

An important element of the policy of telephone exchange management is that having to do with the organization of the central office operating force. A schedule of arrangement of authority accompanies the article and the details of the duties of the various units in the organization are made subject of discussion.

Phases of Long-Distance Telephony—MCMEEN.—*Telephony, December.*

The full text with the drawings and a condensed report of the discussoin of a paper read before the Western Society of Engineers on November 11. The general subjects treated are simultaneous telegraphy and telephony, improvements which have been made and ought to be made in long-distance lines, the character and operation of trunks between the long-distance office and branch offices of an exchange, the use of "booster" batteries in connection with long-distance trunks, and systems of passing long-distance tickets from one switchboard to another by means of pneumatic tubes. There are fourteen figures, all but one of which represent circuits.

Details of Modern Engineering Practice—HAMMER.—*Telephony, December.*

The engineernig practice particularly referred to in this article is that having to do with the construction of telephone systems. The article is illustrated with twenty-two drawings and photographs, showing maps, methods of recording the work done, the routes upon which it is done, details of conductor distribution and material expended. Construction details with reference to the laying of pipe in underground conduit, and the setting of poles by modern apparatus are described, together with an ingenious device which allows the use of a square manhole frame and cover, obviating the annoyances of round frames and also the danger of dropping a square or rectangular cover into the manhole.

The Quality of Telephone Service—MCMEEN.—*Electrical Review, December 17.*

Making telephone service is little other than a manufacturing problem. The operating elements are analyzed into eight units, and it is one of the conclusions that quick answering is not a determining element in quality of service. Quick answering, accompanied by accuracy, speed and a few other important items may be more nearly said to represent good service. Most important of all elements having to do with service manufacture is the existence of a clean-cut method of examining the service from time to time. Two circuits are given, one adapted to enable the chief operator to supervise the character of address of operators, and another enabling a service observing person to note the calls and record their results.

Telephone Engineering—KELSEY.—*Electrical Review, December 10.*

GENERAL TELEPHONE ENGINEERING.

The thirteenth article of Mr. Kelsey's series and deals with three forms of common battery systems classified very wisely as those with "unchanging line conditions." The line condition referred to is that relative to the circuits of it in the central office. All three systems use relays permanently connected to the limbs of the line and a common battery in the central office. The first described, being that of the Sterling Electric Company, the invention of Mr. Fowler, uses a line relay of 200 ohms, with the line and supervisory lamps of different voltages. During conversation these two lamps are below the point of illumination, although both are taking current. When conversation ceases, the line lamp circuit is open and the supervisory lamp responds, as it is getting current enough to give a signal. The second system described is similar to the first in that the relay conditions are quite the same, but an additional relay is associated with the sleeves of the jacks, and the supervisory lamp fails to give a signal during conversation because the resistance of this relay is in series with it. The third system, sharing with the others certain similarities of relay and signal operations, extinguishes its line lamp by breaking a series conductor through all the jacks of the line in the multiple. The advantages and disadvantages of this system are succinctly cast up.

The Automatic Telephone System—HIGGINS.—*Electricity, December 7.*

A general treatment of the automatic system from the point of view of the telephone subscriber. The experience which makes this article timely was gained by its author in his connection with the partly-manual and partly-automatic system in Los Angeles, California. It is admitted by the author that a system in a single city, containing both automatic and manual apparatus, involves confusion and difficulty not existing in a system having only one kind of apparatus. In the main his article is in the way of praise of the automatic system, secrecy, simplicity of operation, correctness in connecting, speed in connecting and disconnecting, and similar general topics being given attention.

Automatic Telephone Systems—HIGGINS.—*Electricity, December 14.*

The continuation of the article noted above, treating in some detail private branch exchanges, the subscriber's telephone instrument and signaling apparatus, the line conditions required with automatic equipments, and a number of special features possessed by manual practice and not by automatic.

Electrical Fire Hazard—WOODBURY.—*Western Electrician, December 10.*

An article of some length on the dangers and precautions incident to electrical systems of signaling and power distribution, treating the matter of protecting telephone lines and apparatus.

High-Frequency Telephone Circuit Tests

DR. A. E. KENNELLY, Harvard University

IN LAND-LINE telegraphy, it has for many years been a custom to test the circuits periodically by applying a steady assigned voltage to their sending ends, and measuring the strengths of current received to ground at their distant ends, through a milliammeter or equivalent apparatus.[1] Fig. 1 shows this well-known arrangement. An e.m.f. E volts is applied to the end A of a line L miles or kilometers in length, and the current-strength i is observed

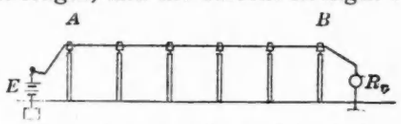

FIG. 1.—TELEGRAPH CIRCUIT TEST.

at B, passing to ground through the instrument of resistance R ohms.

It is known for a uniform line of conductor-resistance r ohms per mile or kilometer; of leakage conductance g ohms.

$$i_r = \frac{E}{R_0 \sinh(La) + R_r \cosh(La)} = \frac{E}{R_1} \text{ amperes} \quad \ldots\ldots (1)$$

where[2]

$$R_0 = \sqrt{\frac{r}{g}} \quad \ldots\ldots \text{ohms} \quad (2)$$

and $a = \sqrt{rg}$ ....per mile or kilometre (3)

The resistance R_0, represented by the denominator of the fraction in formula (1), may be called the "receiving-end-resistance" of the circuit; because it is the resistance which the circuit apparently offers to the applied e.m.f. E, as judged by an observer at the receiving end. If the maximum available e.m.f. at the sending end is, say, 200 volts, and the minimum received current-strength at the receiving end of the line which will operate the signaling relay is, say, 1 milliampere; then the "receiving-end-resistance" of the line must not exceed 200,000 ohms in order that the received current in the steady state may suffice to produce a signal. During the variable states of rapid signaling, the effective "receiving-end-resistance" of the circuit may differ appreciably from that of the steady state. Nevertheless, the steady receiving-end-resistance furnishes a useful and reliable criterion as to the workable condition of the circuit. When the steady receiving-end-resistance of any such circuit exceeds some particular limit, the circuit becomes unworkable and requires the lineman's attention.

As an example of formula (1) the case may be considered of a uniform telegraph line, 345 kilometers long, having a conductor resistance of 15 ohms per kilometer, and an insulation leakance of 1 micromho per kilometer (corresponding to an insulation resistance of 1 megohm-kilometer). An e.m.f. of 80 volts is applied at A. What current-strength will flow to ground B: (a) when grounded directly, (b) when grounded through a measuring instrument of 32 ohms resistance? Here $L = 340$; $r = 15$; $g = 10^6$; $E = 80$; $R_r = 0$ *in* (a) and 32 in (b).

By (2) $R_0 = \sqrt{\frac{15}{10^{-6}}} = 3873$ ohms, the sending-end-resistance for an indefinitely long line.

By (3) $a = \sqrt{15 \times 10^{-6}} = 0.003873$

$La = 340 \times 0.003873 = 1.317$; $\sinh La = 1.7321$; $\cosh La = 2.007$.

$\therefore$ by (1) $i_r = \frac{80}{3873 \times 1.7321} = \frac{80}{6708} = 0.01193$ .....amperes in (a)

and $i_r = \frac{80}{3873 \times 1.7321 + 32 \times 2.007} = \frac{80}{6772} = 0.0118$...amperes (b)

The receiving-end-resistance of the line would be 6,708 ohms in case (a) and 6,772 ohms in case (b).

In the case of a telephone circuit, precisely similar formulæ apply.[3] The conditions are, however, rendered more complex, because instead of a steady current system (frequency = zero) we have a multi-frequency alternating-current system. Each frequency of alternating current obeys the formula:

$$i_r = \frac{E}{Z_0 \sinh(La) + Z_r \cosh(La)} = \frac{E}{Z_1} \text{ amperes} \quad (4)$$

where

$$Z_0 = \sqrt{\frac{r + j\,lw}{g + j\,cw}} \text{ ohms, the sending-end-impedance} \quad (5)$$

$$a = \sqrt{(r + j\,lw)\,(g + j\,cw)} \quad \ldots\ldots (6)$$

n = frequency. cycles per second.
w = angular-velocity = $2\pi n$ radians per second.
r = conductor-resistance ohms per loop mile or kilometer.
l = conductor-inductance henrys per loop mile or kilometer.
g = dielectric-conductance ohms per loop mile or kilometer.
c = dielectric-capacity farads per loop mile or kilometer.
$j = \sqrt{-1}$
E = effective harmonic e.m.f. at A or maximum $/\sqrt{2}$ volts.
i_r = effective harmonic current at B or maximum $/\sqrt{2}$ amperes $\angle$
Z_1 = receiving-end-impedance or maximum ohms $\angle$
Z_r = impedance of receiving apparatus or maximum ohms $\angle$

In order, therefore, to test a telephone circuit for effectiveness, it is only necessary to apply a known effective sinusoidal e.m.f. at A, and to measure the corresponding current strength received at B. The ratio of these quantities will be the "receiving-end-impedance" of the circuit at that frequency. If this impedance exceeds a certain value, assignable for each particular circuit, the circuit will be defective or even inoperative, and will require to be overhauled. It is, moreover, highly probable that the limiting length of circuit over which telephony is commercially possible is that which has a certain definite receiving-end-impedance at a certain standard sinusoidal frequency, whether the circuit is overhead, or underground, mixed, loaded, or natural, and after variations in sending-end-impedance have been taken into account.

It is not, of course, necessary that the measurements shall be made with a simple harmonic, or sinusoidal e.m.f. A mixed frequency or complex harmonic e.m.f. may be used. In that case, however, although the results will be comparable with each other, and with a certain empirical standard, they will cease to be interpretable or checkable by formula (4).

The object of this paper is to describe certain apparatus constructed for the purpose of measuring the alternating-current strength, at telephonic frequencies, received at the distant end of a telephone circuit, with a definite e.m.f. impressed on the sending end. The apparatus, therefore, is one

Paper read at the International Electrical Congress at St. Louis.

1. "*On Testing by Received Currents*" by H. R. Kempe. *Journal* Soc. of Tel. Engrs. Vol. IX, pp. 222-231. (1880.)

2. "*On Electric Conducting Lines of Uniform Conductor and Insulation Resistance in the Steady State*" by A. E. Kennelly. Harvard *Engineering Journal*, May, 1903.

3. "*A Contribution to the Theory of Telephony*" by A. E. Kennelly. *Electrical World*, Vol. XXIII, No. 27; p. 208, February, 1894. *The Electrician*, Vol. XXXIII, No. 841, p. 232, June 29, 1894.

which enables the receiving-end-impedance of a circuit to be measured for a given frequency, or enables that routine test to be made for telephone circuits which has so long been well known for telegraph circuits.

The receiving instrument in such a test should either have negligible impedance, or an impedance of magnitude similar to that of an ordinary receiving apparatus. There is no difficulty in producing an electrodynamometer of sufficient sensibility to enable a telephonic current-strength to be measured under laboratory conditions, but such an apparatus has relatively large inductance, and at a frequency of 1,000 ~, such inductance develops 6,283 ohms reactance per henry, while formula (4) shows that this impedance is multiplied by the hyperbolic cosine of the attenuated-length $L\,x$ in producing its effective share in the receiving-end-impedance of the circuit.

The device selected for the purpose (with Prof. Fessenden's permission) was the "solid barretter" used in the Fessenden system of wireless telegraphy. This consists of a minute loop of very fine platinum wire or filament. Out of several sizes of platinum filament tried, the size which gave the best results has a diameter of about 1.7 microns ($1.7\,u = 0.0017$ mm. $= 0.000067''$) and a length of about 1.5 mm. (0.06″). The resistance of this filament is about 40 ohms per millimetre, or 1,000 ohms per inch, at room temperatures. Such a filament has a cross-section of 2.27×10^{-8} sq. cms. (3.5×10^{-9} sq. in.), and a volume of 3.4×10^{-9} cc. With the specific gravity of 17.5 for platinum, the mass of the filament would be 6×10^{-8} gramme, and with the specific heat of 0.0323 for platinum, one erg of heat, accumulated in such a filament, would suffice to raise its temperature 12.3 deg. C.

To produce a platinum filament of such dimensions, the Fessenden device is seen in Fig. 2. *A* and *B* are two brass strips (25 mm × 6 mm. × 0.7 mm.) pinned, side by side, to a hard-rubber supporting-block *rr*. Copper connecting wires *c*, *c*, are soldered one above. A short v-loop of silver wire *b* is soldered as a bridge at the lower ends. This

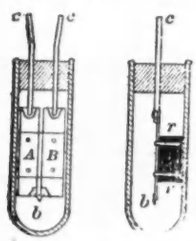

FIG. 2.—FRONT AND SIDE ELEVATION OF BARRETTER.

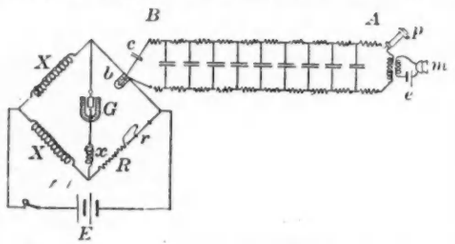

FIG. 3.—CONNECTIONS OF LABORATORY BARRETTER TESTS.

wire has a diameter of about 0.075 mm. (3 mils.), and has a central filament of platinum running through it, like the wick within a candle. The point of the silver v is dipped below the surface of strong nitric acid for a few minutes, and with the aid of a current of some milliamperes from a voltaic cell, the silver is rapidly dissolved away, leaving the platinum filament intact. The process is watched under a microscope, and stopped when the estimated right length of platinum filament has been exposed. The barretter is then protected from injury by being enclosed in a short glass test-tube containing air at the ordinary atmospheric pressure.

In one of the Fessenden systems of wireless telegraphy, a barretter of this kind is connected between the receiving air-wire and the ground. The passage of the feeble electromagnetic waves through the apparatus generates in the filament a small amount of joulean heat, and the sudden small change in the temperature of the filament produces a correspondingly sudden small change in its resistance. By means of a telephone connected in a local circuit through the barretter, the sudden fluctuations of resistance due to the passage of electromagnetic waves produce audible signals.

In adapting the Fessenden barretter to the telephonic circuit test, the arrangement of Fig. 3 was employed. Here the barretter *b* is made one arm of an *inductive* Wheatstone bridge. *X*, *X*, are two similar coils of low temperature-coefficient-resistance wire, wound upon closed magnetic circuits of steel wire, so as to have each 500 ohms resistance, and a relatively large reactance. A smaller reactance-coil *x*, of low resistance, of copper-wire winding, was included in the galavanometer branch. The galvanometer *G* is a wall-pattern d'Arsonval reflecting galvanometer of 620 ohms resistance, with a telescope and a scale at about half-meter distance from the mirror. No attempts were made to secure extraordinary sensitiveness, and 1 mm. of deflection in the telescope represented approximately 10^{-8} ampere. The testing battery consisted of two storage cells (4.0 volts total e.m.f.). The platinum filament in the barretter had a length of about 5 mm., a diameter of 3 *u*, and a resistance of about 125 ohms at ordinary temperatures. Under these conditions a steady battery current of about 6 milliamperes passed through the barretter, raising its temperature some 25 deg. C. A balance at *R*, aided by a slide-wire *r*, was secured at about 135 ohms.

If feeble alternating currents are sent through the barretter, superposed upon the steady testing current, they are practically confined to the arm *b* of the bridge by the reactances *X*, *X*, *x*, and heat the filament above the temperature due to the testing current. It is shown in Appendix I, that for *small* alternating currents, the change in the resistance of the barretter is proportional to the square of the strength of the superposed alternating current.

As shown in Fig. 3, the barretter *b* was connected at the receiving end of an artificial telephone cable lent by the American Telephone and Telegraph Company. This artificial cable has a conductor-resistance of 2,820 ohms, and a capacity of 1.92 microfarads at 15 deg. C. Its *CR* time-constant was, therefore, 0.0054 second. The cable represents 32 loop-miles of standard underground cable of No. 19 B. & S. copper wire (88 ohms and 0.060 mfd. per loop-mile). The electrical length of this artificial cable could be adjusted to even miles. With the condenser *c* short-circuited, and a balance in *R* of 130 ohms, loud singing into the transmitter at *A*, operated by 1 storage cell, or 2 volts, produced a distinct deflection on the galvanometer *G*, representing a received current-strength of nearly 100 microamperes, over the 32 miles of cable. This length represents the limit of "easy commercial" telephonic conversation. As the length of artificial cable in circuit was reduced, the strength of the received current increased, roughly as the inverse square of the length.

It was found practically impossible to obtain steady readings of the current-strength received through the barretter either over different lengths, or even over one and the same length, of the artificial cable, owing to variations in the transmitting apparatus, including the singer. The galvanometer showed that the intensity of the note delivered by the singer could not be steadily sustained for even a few seconds. Moreover, the difference in the effective current at the receiver due to variation in the distance between the lips and the transmitter was very remarkable. The current received, when the lips of the singer were only a few centimeters from the transmitter, was only a small fraction of that received when the lips almost touched the transmitter cone. It was evident, therefore, that the conditions of sound-production at the transmitter would have to be standardized, if consistent and reproducible measurements were to be secured.

A short standard organ-pipe was lent for this purpose by Prof. W. C. Sabine of the Jefferson Physical Laboratory. This pipe sang a fairly pure note of $C'' = 512$ ~ It was connected by an electromagnetically controlled valve to a small air-holder, which, descending under a constant im-

posed weight, maintained a nearly constant amplitude of sound at the lips for half a minute at a time. By setting this pipe immediately facing the transmitter, and at a carefully maintained distance therefrom, fairly consistent measurements of alternating-current strength were obtained, with different lengths of cable in circuit. The results are indicated in the curve sheet of Fig. 4. It will be seen that the received-current strengths are roughly proportional to the inverse squares of the lengths of the cable, the inductance of which was negligible. The received current varied from 0.13 milliampere at 32 miles, to 1.16 milliamperes at 13 miles. The dotted line follows the values calculated from equation (4), taking $E = 1.74$ volts. It will be seen that there is rough agreement between the observed and computed current-strengths. The sources of the discrepancy between them were not, however, investigated.

It is evident that the sensibility of the test depends upon the smallness of the filament's diameter, so that it may become heated by a feebler alternating current, and also upon the minimum increase in resistance that can be accurately determined by the Wheatstone bridge. With 3-micron wire this was about 1/700 of 1 per cent. This represented the effect of a telephonic current strength of 23 microamperes. With 1.7-micro wire in air, the limit was reduced to about 7 microamperes, and with the same 1.7-micron wire *in vacuo*, to 3 or 4 microamperes.

Although such degrees of sensitiveness are attainable under laboratory conditions, and might suffice for measuring telephonic conversation currents at the receiving end of long circuits, yet the reflecting galvanometer is quite unsuited for routine tests at the switchboard. Any galvanometer that can at present be used under switchboard conditions is much more limited in sensibility. If, however, the limit of resistance change to be detected is increased from 1/700 of 1 per cent to 1/10 of 1 per cent, the minimum measurable telephonic current-strength becomes about 1/2 milliampere, with 1.7-micron wire in air. This current strength can be supplied over the longest commercial telephone circuits if an

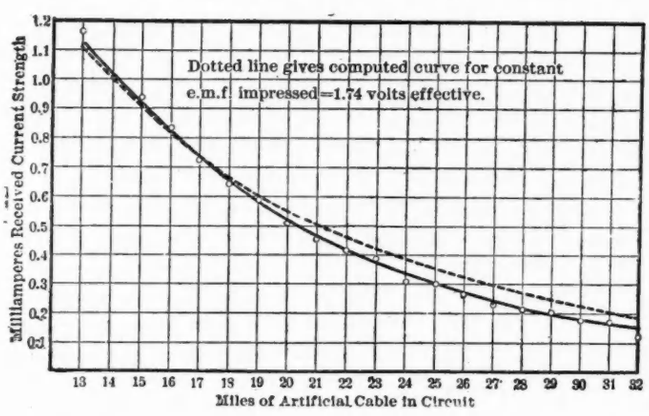

FIG. 4.—CURVE SHOWING RECEIVED CURRENT STRENGTHS AT EACH SUCCESSIVE MILE LENGTH OF ARTIFICIAL CABLE BETWEEN 13 AND 32 MILES.

effective impressed alternating e.m.f. of about 25 volts be substituted, at the sending end, for the transmitter. That is to say, routine tests using switchboard instruments become quite practicable if a standard 25-volt alternator of telephonic frequency can be applied at the sending end of each circuit to be tested.

In order to adapt the apparatus in this manner for switchboard use, a Weston milliammeter, in series with the barretter, was substituted for the reflecting galvanometer and Wheatstone bridge.

The connections of the switchboard apparatus are indicated in Fig. 5, where b is the barretter, with a 2-microfarad condenser in its circuit, to stop the testing current, supplied by the dry cell e, from flowing around the telephone circuit; x is a reactance coil to stop the telephone current from being diverted through the Weston milliammeter m, which gives a full-scale reading of 10 milliamperes over 100 divisions of 1/10 milliampere each. The dry cell e has an e.m.f. of 1.45 volts, and an internal resistance of less than 1 ohm. The resistance of the local circuit is adjusted, with the aid of the rheostat r, until the full deflection of 10 milliamperes is obtained. This requires 145 ohms in the circuit, of which about 120 are in the barretter, at working temperature, 8.5 in the reactance-coil x, 4 in the milliammeter and the remainder, or 12.5, in the dry-cell and rheostat, r.

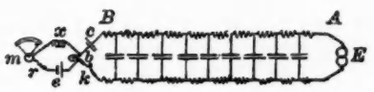

FIG. 5.—BARRETTER AND MILLIAMMETER AT RECEIVING END OF CIRCUIT OPERATED BY ALTERNATOR.

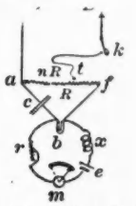

FIG. 6.—CONNECTIONS OF BARRETTER HIGH-FREQUENCY MILLIAMMETER FOR TELEPHONE CIRCUITS.

Pressing the key k allows alternating current from the source E to pass through the barretter, thereby heating it, increasing its resistance, and temporarily reducing the current in the local circuit. Each division of the milliammeter scale represents 1 per cent of the testing current, and 1/10 of a division or 0.1 per cent can be readily estimated. A convenient strength of alternating current is one which will reduce the testing current 1 per cent, or one scale division. The action is very prompt and dead-beat, so that the needle's deviation follows at once upon the movement of the key. It is shown in Appendix II, that the strength of the received alternating current is equal to the square root of the needle's deviation in scale divisions, on pressing the key, multiplied by an instrument-constant, depending on the barretter. Thus in the actual instrument, one division of deviation from the full scale reading represents 1.4 milliamperes of superposed alternating current, with shunt multiplier of unity.

The source of standard alternating e.m.f. E employed with the switchboard testing-set was a small 12-pole inductor alternator, weighing about 2 kilogrammes, and originally designed for a very different purpose. When belt driven, this little machine could readily deliver a few milliamperes at a frequency of 1,200 ~, and, when directly connected to a small motor, 600 ~. The motor consisted of a laminated inductor cylinder with grooves and polar projections. Owing to the peculiar magnetic actions set up during operation, the frequency delivered was very impure. Thus, when running at a speed corresponding to the principal frequency of 1,200 ~, there was a prominent undertone frequency of 600 ~, in addition to overtones of 1,800, 2,400, and higher orders. Moreover, the pressure regulation of this little alternator was very defective, the voltage at terminals varying greatly with the nature and impedance of the circuit to which it was applied. Consequently, although this was the only convenient source of telephonic-frequency e.m.f. available, yet it left much room for improvement. An ideal source of alternating current for these tests should be simple, reliable, consume little power, having constant frequency and terminal e.m.f. with a pure sine-wave.

Since the 1.7-micron wire melts at approximately 14 milliamperes in air at ordinary pressure (about 2.5 milliamperes *in vacuo*), and the steady testing current is 10 milliamperes, the barretter should fuse when the measured superposed alternating current reaches 10 milliamperes ($10 + j\,10 = 14.14$). Consequently the barretter must be protected from alternating currents of more than 3 or 4 milliamperes. The theory of Appendix I also shows that beyond 2 or 3 milliam-

peres of measured alternating current, the readings diminish in accuracy unless the formula of the measurement is complicated by the introduction of a correction. It becomes desirable, therefore, to protect the barretter by an adjustable shunt, as shown in Fig. 6. Here R is a resistance of 2,000 ohms, permanently bridged across the barretter b and 2-microfarad condenser c. By shifting the contact t, to points distant nR ohms from a, where n = 1, 1-2, 1-3, 1-4, 1-5, etc., successively, the multiplying power of the shunt is made 1, 2, 3, 4, 5, etc., on the principle of the Ayrton universal shunt, as shown in Appendix II, for all frequencies of alternating current.

The actual connections employed differ only from those of Fig. 6, by the insertion of compensating resistances in the

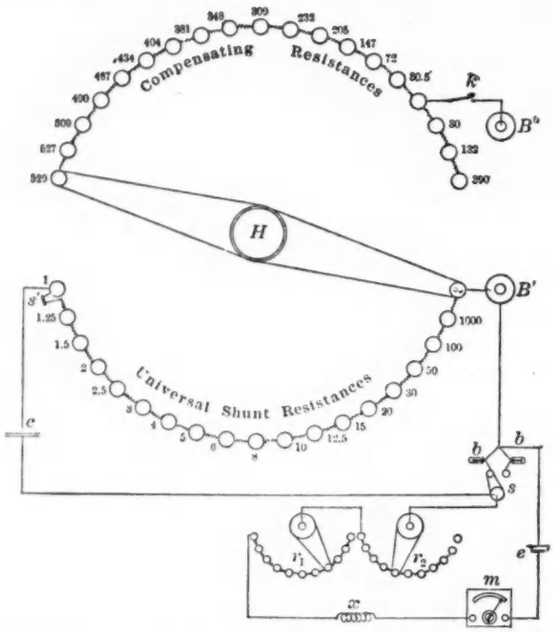

FIG. 7.—DETAIL CONNECTIONS OF BARRETTER MILLIAMMETER FOR TELEPHONE CIRCUITS.

wire kt, so as to keep the impedance of the apparatus constant under all conditions, and about equal to that of an ordinary telephone receiving apparatus at the testing frequency. In the case considered, the frequency selected was 600 ~, and the constant impedance, including barretter, condenser and universal shunt, 529 ohms. The full connections are given in Fig. 7.

B' B'' are the line terminals, connected to the telephone circuit under test, at its receiving end. H is a double-ended ratchet-switch, bridging diametrically across the two semicircular rows of contacts. The upper contacts are separated by the compensating resistances. The lower contacts belong to the universal shunt. In the position shown, the barretter b and condenser c are entirely short-circuited, or shunted with a multiplying power a; while the impedance of the apparatus, between line binding-posts, is 529 ohms, when the key k is depressed. On turning the handle H clockwise from the initial position, the multiplying power of the shunt is gradually reduced to 1, in 18 steps. By this means the instrument has a theoretical range of measurement from 0.5 milliampere to 4,000 milliamperes.

Two barretters b b are installed, under the control of the switch s, one for working, and the other for reserve, in case of accidental fusing. The adjustable rheostats r_1 r_2 of 1/2-ohm and 5-ohm steps, respectively, enable the testing current from the dry cell e to be kept constant at 10 milliamperes, except at such moments when the key k is depressed.

A view of the actual form of barretter receiving apparatus, as constructed by the International Instrument Company of Cambridge for the Engineering Department of the American Telephone and Telegraph Company, is seen in Fig. 8.

The process of testing a circuit with this apparatus consists in applying the required voltage and frequency of alternating e.m.f. at the sending end of the circuit, connecting the receiving ends to the line terminals B' B'', adjusting the

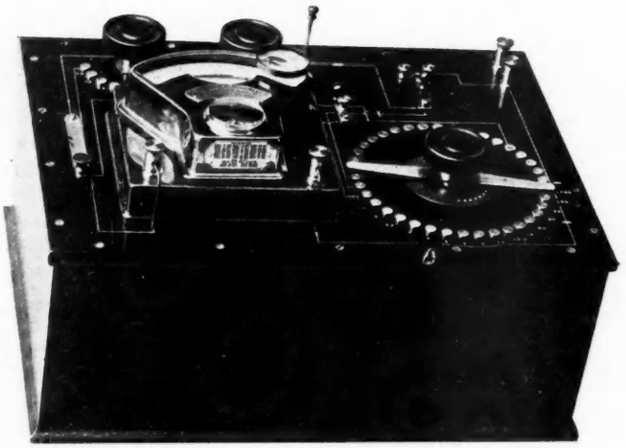

FIG. 8.

steady testing current to the precise value of 10 milliamperes, pressing the testing key with the left hand, and turning the handle of the universal switch with the right hand from point to point by ratchet, until a suitable small deviation of the needle is observed with the magnifying glass on the milliammeter scale. The square root of this deflection times the shunt multiplying-power, times the instrument constant, gives the effective alternating current in milliamperes received through the 529 ohms impedance in the instrument. From this current, and the applied effective e.m.f., the receiving-end impedance follows at once by Ohm's law. If the impressed e.m.f. is pure, or simply harmonic, this observed receiving-end impedance can be compared with its computed value, for the frequency employed. If the e.m.f. is a complex harmonic, the observed receiving-end impedance can be compared with that similarly observed on vary-

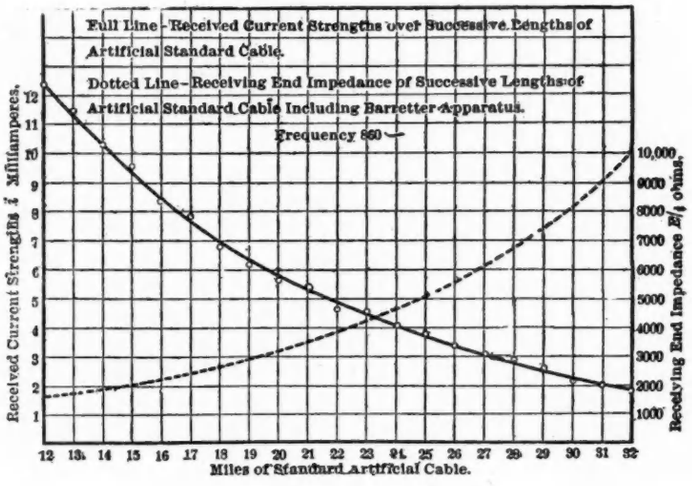
Full Line—Received Current Strengths over Successive Lengths of Artificial Standard Cable.
Dotted Line—Receiving End Impedance of Successive Lengths of Artificial Standard Cable Including Barretter Apparatus.
Frequency 860 ~
Received Current Strengths i Milliamperes.
Receiving End Impedance E/i ohms.
Miles of Standard Artificial Cable.

FIG. 9.

ing lengths of artificial standard underground cable. The comparison will show whether the circuit under test is in satisfactory telephonic condition.

The curves of Fig. 9 show the current-strengths received with the apparatus of Fig. 8 through successive lengths of the artificial standard underground cable above described,

and also the corresponding receiving-end-impedance. In this case the e.m.f. E had a magnitude of from 18 to 20 volts, varying with the length of the circuit, and the frequency was 860~ with component of 430~ and upper harmonics. It will be seen that the received current-strength increased from 1.85 milliamperes at 32 miles to 12.35 milliamperes at 12 miles, and the receiving-end-impedance from 1,650 ohms at 12 miles to 10,000 ohms at 32 miles, with the particular frequencies used. With lower frequencies these impedances would ordinarily be less, and with higher frequencies greater.

The following table gives a few measurements made with the apparatus over various looped circuits, the inductor alternator and the barretter receiving apparatus being in the same room, near the switchboard. The frequency was 600~ (with 300~ and harmonics):

Length of circuit loop. Miles.	Wires Gauge.	Applied e.m.f. E, volts.	Received current. Deflection divs.	Received current. Shunt.	Received current. i. Milli. amp.	Receiving end impedance. ohms.
470	8 B. W. G.	5.9	0.5	1	0.99	5,960
470	8 B. W. G.	25	1	3	4 20	5,950
470 +1 mile ar. cable.	8 B. W. G.	26	0.8	3	3 75	6,925
" " "	–	–	1.2	2.5	3.84	6,760
235 + 235 / 470	8 B. W. G. / 12 N. B. S. G.	24	1.0	1	1.4	17,150
235 + 235 / 470	12 N. B. S. G. / 8 B. W. G.	30	1.2	1	1.53	19.600
470	12 N. B. S. G.	30	0.1	1	0 442	67,800
25	Art. cable.	28	0.8	3	3.75	7.470
26	Art. cable.	28	0.65	3	3 378	6,280

The experimental research described in this paper was undertaken with the assistance of Messrs. Moses King, Jr., and E. A. Stevens, Jr., senior students in the Department of Electrical Engineering at Harvard, in consultation with the Engineering Department of the American Telephone & Telegraph Company, as represented by Dr. H. V. Hayes, H. S. Warren, Dr. G. A. Campbell and G. W. Pickard.

We also desire to express our indebtedness to Prof. R. A. Fessenden, who assisted us with apparatus, barretters and valued suggestions, as well as to Prof. W. C. Sabine for his apparatus and aid.

Appendix. I.

Theory of the Method of Measuring Alternating-Current Strengths by the Change of Barretter-Resistance to Direct Current.

Using the c. g. s. system for simplicity, and the connections of Fig. 6.

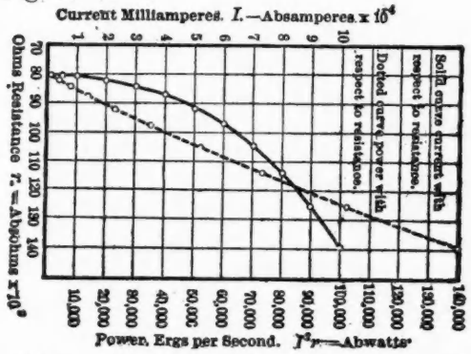
Current Milliamperes. I.—Absamperes x 10⁴
Ohms Resistance r.—Abohms x 10⁹
Power, Ergs per Second. I²r—Abwatts.
Dotted curve, power with respect to resistance.
Solid curve, current with respect to resistance.

FIG. 10.—CURVES SHOWING RELATION BETWEEN THE RESISTANCE r, OF A PARTICULAR 1.7 u BARRETTER, THE CURRENT STRENGTH, I, STEADILY FLOWING THROUGH THE RARRETTER; AND THE POWER I^2r DISSIPATED IN THE RARRETTER.

Let r = the resistance of the barretter b, when heated by the steady testing current (absohms).

$\triangle r$ = the small increase in the resistance r due to the superposition of the feeble alternating current.

I = the strength of the steady direct testing current (absamperes).

i = the effective or square-root-mean-square strength of the superposed alternating current (absamperes).

p = the power dissipated by the barretter b when traversed by the steady testing current (abwatts).

p = the small increase in power dissipated when the alternating current is superposed.

Then $p = I^2 r$ abwatts.

$$p + \triangle p = (I^2 + i^2)(r + \triangle r) \quad "$$

$$= (I^2 + i^2)\left(r + \frac{\triangle r}{\triangle p}\triangle p\right) \quad "$$

$$= (I^2 + i^2)\left(r + \frac{dr}{dp}\triangle p\right) \text{ when } \triangle r \text{ is very small} \quad "$$

$$\therefore \triangle p = (I^2 + i^2)\frac{dr}{dp}\triangle p + i^2 r \quad "$$

$$\therefore \triangle p \left\{1 - (I^2 + i^2)\frac{dr}{dp}\right\} = i^2 r \quad "$$

$$\text{But } \triangle p = \frac{dp}{dr}\triangle r \quad " \quad " \quad "$$

$$\therefore \frac{dp}{dr}\left\{1 - (I^2 + i^2)\frac{dr}{dp}\right\}\triangle r = i^2 r \quad "$$

$$\left\{\frac{dp}{dr} - (I^2 + i^2)\right\}\triangle r = i^2 r \quad "$$

$$i^2 = \frac{\triangle r}{r}\left\{\frac{dp}{dr} - (I^2 + i^2)\right\} \quad \text{(absampere)}^2$$

By actual measurement it is found that in all cases p follows nearly a straight line with respect to r, see Fig. 10, and, at least within the range of r considered, $\frac{dp}{dr}$ becomes a constant for each particular barretter. Thus in Fig. 10, and near 10 milliamperes or $I = 10^{-3}$, $\frac{dp}{dr} = 2700$ ergs per ohm $= 2.7 \times 10^{-6}$ abwatts per abohm.

Let $\frac{dp}{dr} = b$ an approximate constant, which may be called the dissipation-resistance constant.

Then $i^2 = \frac{\triangle r}{r}\left\{b - (I^2 + i^2)\right\}$

and $i = \sqrt{\frac{\triangle r}{r}}\sqrt{b - (I^2 + i^2)}$ absamperes.

Thus in the case of Fig. 10 for $i < 2$ milliamperes,

$$i = \sqrt{\frac{\triangle r}{r}}\sqrt{2.7 + 10^{-6} - 10^{-6}}$$

$$= \sqrt{\frac{\triangle r}{r}}\sqrt{1.7 \times 10^{6}}$$

$$= \sqrt{\frac{\triangle r}{r}}\ 1.304 \times 10^{-3}$$

For $\frac{\triangle r}{r} = 0.01$ or 1 per cent $\sqrt{\frac{\triangle r}{r}} = 10^{-1}$

$i = 1.304 \times 10^{-4}$ absamperes.

$= 1.304$ milliamperes.

Thus if $\sqrt{b - I^2} = c$ the barretter-constant,

then $i = \sqrt{\frac{\triangle r}{r}} \times c$ absamperes.

$= \sqrt{\frac{\triangle r}{r}} \times c^1$ milliamperes.

where $c^1 = c \times 10^4$.

Or the alternating-current strength in milliamperes will be a constant times the square root of the proportionate increase in barretter resistance due thereto.

The sensibility of the method, or the minimum current which can be measured, depends upon the minimum proportionate increase in resistance $\triangle r/r$ that can be determined, and upon the magnitude of $b = \frac{dp}{dr}$ the dissipation per unit

increase of resistance; also, in lesser degree, upon the strength I of the testing current.

When the barretter of Fig. 10 was sealed within an exhausted glass vessel, the testing current I was reduced to 1.5 milliamperes, or 1.5×10^{-4} absamperes and b to 90 ergs per ohm $= 9 \times 10^{-8}$ abwatts per absohm. From these values $c = 2.6 \times 10^{-4}$

$$i = \sqrt{\frac{\triangle r}{r}} \times 2.6 \times 10^{-4} \quad \text{absamperes.}$$

If the least determinable change in resistance is 1/7000 of 1 per cent;

then $$i = \sqrt{\frac{1}{700{,}000}} \times 2.6 \times 10^{-4} = 3.1 \times 10^{-7} \quad \text{absamperes.}$$

$$= 3.1 \quad \text{microamperes,}$$

Appendix II.

Theory of Determining the Proportionate Increase in Resistance of a Barretter (and Hence the Alternating-current-strength) by a Milliammeter in Direct Series Circuit as in Fig. 5.

Let r = the res: of the barretter under steady test (absohms).

R = the res: of the barretter circuit steady test (absohms).

e = the e.m.f. of the dry cell (abvolts).

I = the steady testing current (absamperes).

Then $$I = \frac{e}{R}$$

$$\frac{dI}{dr} = -\frac{e}{R^2} = -\frac{I}{R}$$

$$\therefore \frac{dI}{I} = -\frac{dr}{R}$$

$$\therefore \frac{\triangle I}{I} = -\frac{\triangle r}{R} \text{ when } \triangle r \text{ and } \triangle I \text{ are small}$$

$$\text{or } -\frac{\triangle I}{I} = \frac{\triangle r}{r} \times \frac{r}{R}.$$

The proportionate change in current as indicated by the milliammeter will be less than the proportionate charge in barretter by resistance in the ratio r/R

$$\text{or } \frac{\triangle r}{r} = -\frac{\triangle I}{I} \times \frac{R}{r}.$$

In order to make the minimum $\frac{\triangle r}{r}$ observable, the resistance of the barretter should be as large a proportion as possible of the resistance of the circuit.

If $\frac{R}{r} = d$ a constant of the circuit

$$\frac{\triangle r}{r} = -\frac{\triangle I}{I} \times d.$$

By observing the proportionate diminution of current $-\frac{\triangle I}{I}$, the proportionate increase in resistance is thus deducible.

Theory of the Universal Shunt with Alternating Currents.

Referring to Fig. 6, let R be a constant non-inductive resistance constantly connected to the barretter b and condenser c. Let Z be the vector impedance of the condenser at the particular frequency or association of frequencies employed, absohms, $\angle$. Then the multiplying power of the shunt R permanently applied is

$$N = \frac{R + z + r}{R} \quad \text{(vector).}$$

If now the contact t is shifted from f along R to some position distant electrically nR from a; then

$$N^1 = \frac{R + z + r}{nR}$$

$$= \frac{N}{n}.$$

If n be taken as ½, 1/3, ¼, etc.,

$$N^1 = 2\,N,\ 3\,N,\ 4\,N, \text{ etc.}$$

Consequently it is unnecessary to know the impedance Z offered by the condenser. It is sufficient to maintain the resistance R constantly connected, to calibrate the apparatus under this condition, and then obtain desired shunt by bringing out a contact-position at the corresponding point of the resistance R. The only drawback is the permanent reduction in sensitiveness of the apparatus by the constant shunting of the resistance R, even when the contact t is connected at f. If, however, $R = 2000$; while $(z + r) = 200 < \overline{53°}$

$$N = \frac{2126 < \overline{4°.19'}}{2000} = 1.063 < \overline{4°.19'}$$

so that the permanent loss of sensibility is only 6.3 per cent.

With the universal shunt aplied, the formula for the instrument becomes

$$i = n\,N\,d\,c^1 \sqrt{\frac{\triangle I}{I}} \quad \text{milliamperes}$$

$$= nK \quad \overline{\triangle I} \quad \text{milliamperes}$$

where n is the multiplying power of the universal shunt, K is the constant of the instrument with the full shunt R applied and the testing current I; while $\triangle I$ is the small diminution in testing current-strength (as read off in scale-divisions) due to the action of the alternating current.

Appendix III.

Series of Practical Tests With the Apparatus.

Since the paper was written, the engineering department of the American Telephone & Telegraph Company has made a series of tests with the apparatus from day to day, on a loop of open-wire circuit from Boston to Bedford, N. Y., and return, with a view to ascertaining the variations which might occur in repeating the received-current test on the same circuit day after day under conditions kept as nearly the same as possible. Owing to the fact that no high-frequency alternator has been available of sufficiently good regulation to afford a constant impressed voltage from day to day, the impressed voltage at the sending end had to be observed simultaneously with the current at the receiving end. The observations are tabulated below. It will be seen that the receiving-end impedance varied from 10,600 ohms to 13,000 ohms, being affected apparently by the insulation of the circuit.

Date.	Impressed voltage.	Barreter number.	Insulation of circuit megohm-miles.	Shunt multiplier.	Deflection.	Receiving end impedance ohms.
July 22.....	33.85	7	6.67	1.25	2.0	12,800
22.....	33.85	9	6.67	1.25	1.9	13,100
26.....	30.78	7	9.85	1.25	1.8	12,200
26.....	30.78	9	9.85	1.25	1.6	13,000
27.....	30.78	7	8.53	1.25	1.9	11,900
27.....	30.78	9	8.53	1.25	1.7	12,600
28.....	30.78	7	5.14	1.25	1.8	12,200
28.....	30.78	9	5.14	1.25	1.7	12,600
29.....	30.78	7	13.26	1.25	1.8	12,200
29.....	30.78	9	13.26	1.25	1.7	12,600
August 5.....	30.16	7	8.93	1.25	1.7	12,300
5.....	30.16	9	8.93	1.25	1 8	12,000
8.....	29.54	7	5.43	1.25	1.7	12,100
8.....	29.54	9	5.43	1.25	1.7	12,100
10.....	30.78	7	2.35	1.25	1.8	12,200
10.....	30.78	9	2.35	1.25	1.7	12,600
11.....	30.16	7	8.53	1.25	2.0	11,400
11.....	30.16	9	8.53	1.25	1.7	12,300
12.....	30.78	7	6.93	1.25	2.0	11,600
12.....	30.78	9	6.93	1.25	1.9	11,900
14.....	30.78	7	0.63	1.25	2 4	10,6 0
14.....	30.78	9	0.63	1.25	2.1	11,300
17.....	33.24	7	12.08	1.25	2.1	12 200
17.....	33.24	9	12.08	1.25	2.0	12,500

Circuit tests of loop of 384 miles of two No. 12 N. B. S. G. copper overhead wires (plus underground wires in Boston city limits). Resistance per loop mile, 10.5 ohms. Capacity per loop mile, 0.008 microfarad. Inductance per loop mile, 3.66 millihenrys. Insulation as above. Frequency about 300.

CITY OF WICHITA FAILS IN ITS SUIT AGAINST MISSOURI & KANSAS TELEPHONE COMPANY.

THE controversy between the city of Wichita, Kansas, and the above company, which has been before the Kansas courts for two years, in which the city sought to annul the franchise of the company and to oust it from the public streets, owing to a failure on the part of the company to comply with certain provisions to collect what the telephone company thought to be unjust taxes from it, has been recently decided in the United States Circuit Court of Appeals, Eighth Circuit, against the city. The facts leading up to this controversy were more fully stated in the October, 1903, issue of TELEPHONY.

The principal ground on which the city claimed a right to drive out the company rested on a statute of the state (laws 1881, page 84), which vested in the mayor and council power "to grant the right of way for the erection of telegraph or telephone posts and wires along and upon any of the streets, alleys or ways of the city, and change, modify and regulate the same." The telephone company claimed its right to exist under another statute of the state (Gen. St. 1868, c. 23), which provided: "Corporations created for the purpose of constructing and maintaining magnetic telegraph lines are authorized to set their poles, wires and other fixtures along and across any of the public roads, streets and waters of the city in such manner as not to incommode the public in the use of such roads, streets and waters." Also under the following statute (laws 1885, page 151) authorizing the formation of telephone companies: "All such corporations shall have all the rights and powers conferred, and be subject to all the liabilities and duties imposed by the general laws of this state upon telegraph corporations." Plainly the statute relating to cities and the general statutes relating to telephone and telegraph companies conflict. The court of appeals said in disposing of the controversy: "In the one case by the letter of the statute the mayor and common council of cities are vested with authority to prohibit the exercise of a right granted by the legislature of the state. In the other case the municipal authorities are authorized to grant, and by implication to refuse, a right of way already granted by the state statute. * * * The power to prohibit is as incompatible with the exercise of a right as the power to grant the same right. * * * The cardinal rule is that repeals by implication are not favored. We believe that the legislative purpose is given effect when the right granted by the general statute is preserved on the one hand and the full exercise of the police power by way of regulation is upheld on the other."

The court cited the following cases, which declare this rule in the jurisdictions in which they have been decided:

American Union Telephone Co. v. Town of Harrison, 31 N. J. Eq. 627.
Rochester v. Bell Telephone Co., 64 N. Y. Supp. 804.
Zanesville v. Telegraph & Telephone Co. (Ohio), 59 N. E. 181.
Abbott v. City of Duluth (C. C.), 104 Fed. 833.

The following pertinent language was also used in the opinion: "Furthermore, the extraordinary power which the mayor and council of the city of Wichita are seeking to exercise is such as can only be sustained when resting on unquestioned right. The local telephone exchange of the Kansas & Missouri Telephone Company has existed for twenty years. It has been built up gradually, representing an investment of many thousands of dollars. The municipal authorities claim the power to destroy this large property. Their contemplated action can have no other result. A telephone exchange is not movable property; to remove it is to destroy it. The city makes no complaint that the telephone corporation has not faithfully complied with all municipal regulations. It is our conclusion that it does not possess that power."

The decree of the Supreme court of Kansas was affirmed by each of the court of appeals with the exception of Circuit Judge Van Devanter.

City of Wichita v. Old Colony Trust Co., 132 Fed. 641.

ELECTRIC COMPANY LIABLE FOR FAILURE TO INSULATE WIRES.

Negligence on the part of an electric company to insulate its wires, whereby an adjacent telephone wire became charged and caused a death is enough to make the electric company liable without regard to knowledge of the fallen wire or diligence in discovering it.

Parsons v. Charleston Consolidated Gas & Electric Co., 48 S. E. 248.

CONTRACT BROKEN BETWEEN INDIANA PARTIES.

One Charles Leininger entered into a contract in the above state with John G. Foster, whereby in consideration of Foster's conveying in writing to Leininger the right to construct, maintain and operate a telephone line along and upon a highway which crossed Foster's property, Leininger agreed to place in the residence of Foster a telephone and connect it with the Seymour telephone exchange and to keep same in repair for five years. The instrument conveying the right of way to Leininger was delivered by Foster, who requested the former to place the telephone in the residence and to connect the same with the telephone exchange. Leininger repudiated the agreement and suit was brought on the contract to recover damages alleged to be five hundred dollars. One of the things which Foster agreed to do was to erect poles suitable to carry the telephone wire of the defendant to the residence. This, it would seem, was a necessary condition precedent to the placing of the wire. Leininger, however, having refused to carry out his part of the contract, the question arose whether it was Foster's duty to erect the poles before he could stand in a position to demand damages for the non-completion of the contract on the part of Leininger. The Appellate court of Indiana in disposing of the case said:

"It is a firmly established rule of law that it is unnecessary to allege performance, or even readiness to perform, on the part of the plaintiff when it is shown that the defendant has repudiated the contract or affirmatively refuses to perform it, or denies liability under it."

It was therefore unnecessary for Foster to erect the line of poles before he stood in a position to demand damages for non-performance of the contract. In the lower court it was decided that owing to a failure on the part of Foster to comply with all the conditions before he began suit,

he had no cause of action. The Appellate court, however, reversed this finding and has sent the case back to the Jackson County Circuit court for a new trial.
Foster v. Leininger, 72 N. E. 164.

EJECTMENT PROCEEDINGS AGAINST COMPANY.

In a New York case one Little owned the fee in a highway to the center, and the American Telephone & Telegraph Company was a trespasser in the erection of telephone poles therein, and it has been held that Little was entitled to maintain ejectment to oust the defendant company from the use of the highway, and that he was not required to bring a suit in equity in which the defendant's equitable rights could be established.
Little v. American Telephone & Telegraph Co., 89 N. Y. S. 136.

RIGHT TO ERECT POLES ON NEW YORK STREETS.

The New York statutes of 1890 gave to a telephone company the right to erect and maintain the necessary fixtures for its wires over any of the public roads and streets within the state. The statutes of 1897 authorize the trustees of villages to regulate the erection of telephone poles and the stringing of wires over the streets. The trustees of a village adopted a resolution authorizing one to erect poles and fixtures and to string wires for a telephone system under the direction of the trustees, and declared that if the work was not completed within a specified time the consent of such trustees should cease. It has been held that the *franchise* to use the streets comes from the *state* and that the power to *regulate* the erection of the poles and wires in the streets of a village rests in the trustees, making it immaterial whether the consent granted by the village had or had not expired.

The above ruling was made in the case of the Union Telephone Company v. Marsh, recently decided by the New York courts. The decision is very similar to that which is found at another place in this department in the case of the City of Wichita v. Old Colony Trust Company. In that case a statute of the state of Kansas authorized telephone companies to occupy streets, etc., similar to the New York statute. Another statute of Kansas authorized cities to regulate these companies, which corresponds to the statute in New York. The contention in both of these cases has been on the part of the city interests to make the statute conferring power upon the city to regulate and control, to also destroy or to prevent the operation of telephone companies; on the part of the companies the contention has been that the general authority to operate within the state is superior to that granted the municipalities, and that the municipalities only have the authority to regulate the companies.

The ruling in both cases is favorable to the telephone companies of these two states. The court in the Marsh case said on the question of the rights acquired on condemnation proceedings to erect poles and lines in front of an owner's property, that the company should only be permitted to acquire an easement for its poles and wires in the streets.
New Union Telephone Co. v. Marsh, 89 N. Y. S. 79-96 App. Div. 122.

PERSONAL INJURY CASE IN OHIO.

In a case where a person in using a highway was injured by coming in contact with a telephone wire which had fallen on the wires of an electric railway company, which used the same support for its wires as did the telephone company, and this detached wire had become heavily charged with electricity, it has recently been held in an action for personal injuries that it was a question for the jury whether the telephone company was negligent in failing to properly guard its wires, and it was proper to deny a motion to take the case from the jury and render a judgment for the telephone company.
Burton Telephone Co. v. Gordon, 25 O. Circuit Ct. R. 641.

CONTRACT DECLARED FORFEITED.

An interesting case recently decided by the Chicago courts is authority for the ruling that when a company makes a contract with a subscriber which in terms cannot be assigned except on the consent of the company, the act of selling the business on the part of the subscriber put an end to the contract. The case in which this ruling was made arose between one Williams of the Chicago board of trade, in which a contract with the telegraph company provided for the furnishing of board of trade quotations, it also being stipulated that no assignment could be made without the consent of the company. The business was sold and the contract was declared to be at an end.
Sullivan v. Chicago Board of Trade, Ill. App. 492.

TELEPHONE COMPANY AND TRACTION COMPANY JOINTLY CHARGED WITH NEGLIGENCE.

A case was heard some months ago in the United States Circuit court for the Southern district of Ohio, in which it was alleged that a telephone company negligently allowed a feed wire of a traction company to remain in contact with an iron spike driven into one of its poles for a step, and that the insulation at the point of contact became worn and defective, resulting in the charged wire coming in contact with the spike, by reason of which one Thomas J. Graves, an employe of a third company, received a shock of electricity, which injury, plaintiff averred, was due to the negligence of the telephone company and the traction company concurrently. The omissions of duty claimed against the traction company were its failure to properly insulate the feed wire; to provide a guy wire with a circuit breaker to prevent a contact of the guy wire with the pole of the telephone company, its failure to prevent the displacement of the feed wire, and its lodgment on the iron spike of the telephone company's pole, and to remove it therefrom. It was charged that the telephone company was negligent in that it failed to remove the feed wire from the iron spike and to prevent the contact of the guy wire with the wooden pole. The two companies were sued jointly, but demurred to the complaint on the ground that if there was negligence on the part of either of them they did not concur in the injury, and that the suit should have been commenced against them individually, if at all.

Many cases have arisen of late in which injuries have been traced to telephone companies and traction companies, in which the two have been jointly charged with liability, and the discussion in the Ohio case is helpful in disclosing the rule of law to be applied. In citing a Maine case (51 Atl. 245) the United States court quoted the following:

"While it is true that persons who, acting separately and independently, each cause a separate and distinct injury, cannot be sued jointly, even though the injuries may have been precisely similar in character and inflicted at the same moment, yet if such persons acting *independently* by their several acts directly contribute to produce a *single injury*, each being sufficient to have caused the whole injury * * * they are joint wrong-doers and may be sued jointly or severally at the election of the plaintiff, and in such an action against one or more, the whole damage may be recovered. The injury, of course, was single, and was caused, if at all, through the error of the telephone company and the traction company acting together. The demurrer, therefore, was overruled.
Graves v. City & Suburban Telegraph Asso., 132 Fed. 387.

Conventions of Independents

INTERSTATE INDEPENDENT TELEPHONE CONVENTION.

THE main object accomplished at the fourth annual convention of the Interstate Independent Telephone Association, held at the Auditorium Hotel in Chicago, December 13, 14 and 15, was the decision on the part of the Interstate body to consolidate with the National Telephone Association of America, and thus form one powerful organization—a decision, by the way, which will meet with universal approval among the Independent workers. There was but little opposition to the consolidation movement at any stage of the proceedings, and when it came to a vote the proposition carried overwhelmingly.

The first session opened Tuesday afternoon with President Henry A. Barnhart of Indiana in the chair. E. M. Coleman of Kentucky officiated as chairman. A committee on credentials was appointed, consisting of W. Mathews of Kentucky, F. C. Holdoegel of Iowa, and W. R. Fee of Ohio. The resolution passed by the last convention, which recommended that at future meetings no one be admitted to any session without proper credentials, was quoted by Mr. Holdoegel, who moved that the word "executive" be inserted before the word "sessions." The motion was carried.

President Barnhart in his annual address, after extending fraternal greetings to the members of the association, dwelt upon the wonderful growth of the Independent movement in the past year and referred to the substantial prosperity which the Independents in all parts of the country are experiencing.

Secretary Coleman in his address to the convention said that notwithstanding all opposition, the growth of the Independent movement had been phenomenal, there being more than 3,000,000 Independent telephones in service to less than 2,000,000 Bell, and with Independent toll lines connecting with all parts of the country.

George N. Bandy of Iowa was called upon for the report of the committee appointed to investigate the attitude of express companies toward Independent telephones. Mr. Bandy briefly stated that as express companies had generally changed the methods complained of he had thought it unnecessary to make a detailed report. The reports of the committees on freight rates, railroads, on Postmaster-General Payne's order, and the special committee on uniformity of equipment and standardization of apparatus, were deferred.

Secretary Coleman addressed the meeting concerning the question of the consolidation of the Interstate Independent Telephone Association with the National Telephone Association of America. He said that he and some of his associates had taken such steps as would warrant them in suggesting that a plan had been outlined for the consolidation of these associations.

The secretary then read from the minutes of a conference of representatives of the Interstate Independent Telephone Association and the National Association. At this meeting, which was held at the Auditorium Hotel, Chicago, on November 18, 1904, the representatives for the Interstate association were E. M. Coleman, Charles E. Hull and Henry A. Barnhart, and those for the National association were James B. Hoge, J. G. Splane and Ed L. Barber. This conference effected formal organization by the election of Mr. Hoge as chairman, and Mr. Barnhart as secretary. It was agreed at the conference that the Interstate representatives should take this matter up before the convention in Decembr and submit it to a committee to be appointed by the delegates at this convention. At this conference Mr. Coleman and Mr. Hoge both presented communications outlining the conditions and the importance of a consolidation of the two associations. It was the opinion of the joint committee, after full discussion, that a permanent consolidation should be effected; that a committee of ten be appointed, five men representing the National association and five men representing the Interstate association; that this committee of ten determine when another convention of the Independent operators should be held, which should be a joint meeting of the two associations, under the plan that might be adopted by the ten men constituting the joint conference. The object of this joint meeting would be the ratification of the work of the joint committee.

A thirty-minute recess was then taken, after which the association went into executive session, when the proposition for consolidation of the two associations was brought up for consideration. After a thorough discussion of the matter, it was decided that a committee of five be appointed, of which the president of the association should be a member, the newly elected president and secretary of the association two others, the fourth and fifth to be appointed by President Barnhart.

Following the executive session, the convention was adjourned to meet at 2 p. m. on Wednesday.

The Wednesday afternoon session was interesting. O. M. Blake, vice-president of the Miami National Bank of Hamilton, Ohio, being ill and unable to be present, his paper, entitled "Why Independent Telephone Securities Do Not Command the Market Price They Deserve According to Their Earning Capacity," was omitted.

Theodore Thorward of South Bend, Indiana, president of the Indiana Independent Telephone Association, read an interesting paper on "What the Independent Telephone Companies Owe the Public. What the Public Owes the Independent Telephone Companies," in which he called attention to the necessity of giving the public the benefit of a good toll line connection with surrounding Independent systems. He said that all owners of public franchises have distinct duties, and that in this respect the Independent telephone companies can profit by the mistakes of the Bell people. If a telephone company is doing all that it can to give good service at reasonable rates, it is entitled to the hearty support of the public. The public should be willing to pay a fair rate for service, and in case the company had erred in accepting too low a rate in its franchise the public should be willing that the error be corrected.

The paper brought out a lengthy and animated discussion, in which the question was raised as to the attitude of the Illinois Telephone Company in Chicago toward the Independent companies which are trying to get into the Chicago field. A. B. Conklin, treasurer of the Interstate association and an official of the Interstate Independent Telephone and Telegraph Company, was called upon for his views, as his field of operations immediately adjoins the Chicago territory. Mr. Conklin replied that while his company had not been turned down by the Illinois company, yet it was feeling somewhat discouraged in the matter. The management had made application for connection with the Illinois company's Chicago lines and had even offered to put in the connecting line at their own expense, but had not yet received the desired permit. Action had been postponed by

the Illinois company from time to time. Mr. Conklin stated that the matter was of considerable importance to Chicago people, as the Interstate company could now give them access to 75,000 telephones over the first-class lines.

A committee of three was appointed to wait on the Illinois Telephone and Telegraph Company and report at the next session as to prospects for getting a connection with the city of Chicago. If unable to obtain such information by that time, this committee was to report at a later meeting. Messrs. Barber, Veneer and Thorward were appointed on this committee.

E. D. Graham of the Mexico Telephone Company, Mexico, Missouri, read a paper on the subject, "Manufacturers' Duties and Their Dues." Mr. Graham declared that it is the efficiency of the service that counts and that this efficiency cannot be attained without good construction and good apparatus. It is the duty of Independents, he said, to uphold the hands of the people who make good apparatus and to encourage Independent manufacturers as far as possible.

He likewise urged the manufacturers to be loyal and protect the operator who uses his goods, thereby placing himself in a position to demand his just credit from the operator.

"Uniformity of Equipment and Standardization of Apparatus the Imperative Demand in the Operating Field" was the subject assigned to J. H. James, president of the Minnesota Independent Telephone Association, but owing to his inability to be present Mr. James' paper was read by John E. Jones of Jonesboro, Arkansas. The paper pointed out the necessary elements which enter into the successful manufacturing of telephone apparatus, and the importance of a standard line of instruments. Mr. Jones urged the Independent telephone companies to take prompt action to obtain the highest possible standard of perfection on all their apparatus. He said that the stability of their investments and the perpetuity of their cause demanded the adoption of standard construction and equipment throughout the telephone field, urging immediate action by the association in this direction.

A lively discussion of this paper followed, after which adjournment was taken until Thursday.

The final session of the convention was held Thursday forenoon. President Barnhart first appointed the following nominating committee to select officers for the ensuing year: Messrs. Lichty of Iowa, Graham of Missouri, Hull of Illinois, Mathews of Kentucky, Harper of Wisconsin, Fee of Ohio and Reeves of Indiana.

An interesting discussion was evoked by the subject which had been assigned to O. M. Blake of Hamilton, Ohio, "Why Independent Telephone Securities Do Not Command the Market Price They Deserve." It was declared that the proper way for the Independent operators to secure investments in their plants is to first secure the support of their friends and neighbors who have a knowledge of the plant and confidence in the men running the company, and through this confidence outsiders will come in and invest their money in Independent securities. The practice of brokers calling in Bell men to determine the value of these securities was ascribed as one of the principal reasons why Independent securities are not valued by investors according to their earning power.

The committee appointed to wait on the Illinois Telephone and Telegraph Company reported through the chairman, Mr. Barber, that the president of the company, Mr. Wheeler, stated that if the Independent companies would bring their lines to the city limits, with the assurance that standard equipment was used, this company would be able to entertain a proposition in from three to six months from any company desiring to enter Chicago. President Wheeler further stated that the Illinois Telephone and Telegraph Company is as anxious to obtain connections with the surrounding Independent companies as anyone else, and would do all possible to push the work.

Mr. Barber said that, from the remarks of President Wheeler, he thought any first-class construction and equipment would be acceptable. There being no better constructed system in the country than that of the Interstate company now seeking entrance into Chicago, a motion was made and carried that the committee, with Mr. Conklin of the Interstate company added, be further instructed to go to President Wheeler and present to him in a proper manner the facts concerning the Interstate lines, and ask for a connection as soon as possible, according to the promise made by him to the committee.

Only one of the four papers announced on the programme was read, Senator Rome C. Stephenson of Rochester, Indiana, presenting an excellent paper on the subject, "How to Avoid Personal Injury and Responsibility in Telephone Construction Work and Maintenance." This paper pointed out how to protect the different companies from damages for such personal injury. It urged that only material of the best character be used and that it be thoroughly inspected by an engineer, and that great care be taken in building lines. A number of experiences different companies have had in the different suits for personal injuries were brought out and a number of important decisions of suits were given. A discussion followed, in which a number of the operators spoke of their experiences in suits for personal injury, and it was urged that Independent companies use only the best construction and secure the service of competent men in building lines.

L. L. C. Brooks of St. Paul, chairman of the committee appointed to confer with the United States Postoffice Department concerning the order issued by Postmaster Payne to the effect that only Bell telephones should be used in postoffices, was unable to be present, and his report was read by the secretary. The report of Treasurer A. B. Conklin was read. It showed that the only funds on hand consisted of the money received from new members during the convention. Mr. Barber of Ottawa, Illinois, was appointed chairman of a committee to audit the bills and liquidate all just claims.

A committee of two from each state was appointed to gather information as to the condition of Independent toll lines and forward same to the committee which is to wait upon the management of the Illinois Telephone Company, said committee to report not later than January 15, 1905. The names of the committee will be announced to the secretary later.

President Barnhart announced the committee on consolidation to meet with a similar committee from the National Association as follows: Theodore Gary, Macon, Missouri; L. L. C. Brooks, St. Paul, Minnesota; H. F. Barnhart, Rochester, Indiana; E. M. Coleman, Louisville, Kentucky; C. E. Hull, Salem, Illinois.

Officers for the ensuing year were recommended by the nominating committee and elected as follows:

President, Theodore Gary, Macon, Missouri; vice-president, William R. Fee, Milford, Ohio; secretary, L. L. C. Brooks, St. Paul, Minnesota; treasurer, A. B. Conklin, Aurora, Illinois. Executive board, C. E. Hull, Salem, Illinois; S. S. Lichty, Vinton, Iowa; J. G. Splane, Pittsburg, Pennsylvania; Richard Valentine, Janesville, Wisconsin; W. Mathews, Maysville, Kentucky; E. D. Graham, Mexico, Missouri; Charles W. Wells, Marion, Kansas; H. F. Barnhart, Rochester, Indiana; W. Guy Jones, Columbus, Ohio.

The convention then adjourned.

* * *

INDEPENDENTS JOIN THE EASTERN TRAFFIC ASSOCIATION.

Representatives of the Independent long-distance concerns in Western Pennsylvania, West Virginia and Maryland recently met in Cumberland, Maryland, and voted

unanimously to join the Eastern Traffic Association of Independent Telephone Companies.

The association is now very strong in the east, and the accession at Cumberland means another link westward in the first attempt of the Independent people to give a transcontinental, or what might be termed an interstate long-distance service in competition with the Bell company. Represented at the Cumberland meeting, besides all the principal Independent lines of Maryland and West Virginia, including the Maryland Telephone Company of Baltimore, and the Consolidated Company of Fairmont, West Virginia, were the leading anti-Bell companies in Western Pennsylvania, including the Pittsburg & Allegheny Telephone Company, the Pittsburg-Johnstown Long-Distance, the Johnstown Telephone Company, the Tri-State Telephone Company of Uniontown, Connellsville and the coke region generally; the Somerset County Telephone Company, the United Telephone and Telegraph Company, which operates between Altoona and Philadelphia; the Huntingdom & Clearfield Telephone Company, which has lines in the north of Cambria county, and a number of others.

As a result of the new move, the long-distance service of all the lines concerned will be controlled for an interchange of business; a uniform rate of charges will be established, and a uniform standardization of the system perfected. All money for long-distance service beyond the territory of the respective lines will be forwarded to the proper exchanging companies, and in many ways an improved and enlarged service will be made possible.

* * *

WISCONSIN INDEPENDENT TELEPHONE ASSOCIATION.

On January 25 and 26, the annual convention of the Independent Telephone Association of Wisconsin will be held in Milwaukee. The headquarters will be at the Pfister Hotel, where the meetings also will be held. A fine programme has been prepared, including a number of papers by prominent Independent telephone men of the Badger state and elsewhere. Matters of great importance to the state will come up for discussion. A big attendance is anticipated. The officers of the association are: President, Richard Valentine, Janesville; vice-president, H. G. Slater, Waupaca; secretary-treasurer, H. C. Winter, Madison.

* * *

OHIO COMMITTEE HOLDS SESSION.

The meeting recently held in Columbus, Ohio, of the executive committee of the Ohio Independent Telephone Association, to arrange for the annual state convention to be held in Columbus early next spring, calls attention to the close organization which these companies are forming throughout the country.

Letters from James B. Hoge of Cleveland, president of the National association, assured the committee that the work of combining the Independent companies into a strong federated position is progressing most satisfactorily. In his opinion, the coming year will see these companies thoroughly federated, and in a position to make a strong fight against any attack on them. The great rival of the Independents, the Bell, is a compact organization, and the Independent association is to be to the Independents what the American Telephone and Telegraph Company is to the Bell properties.

It is not the intention to consolidate the local exchanges, but to leave them in the hands of local men. The promoters of the association believe that a federation for mutual protection will be able to accomplish more than could any one company in control of all the Independent plants. The long-distance lines will, however, be consolidated, and it is along this line that work is being done. It is not expected that a holding company for all the Independent long-distance lines will be incorporated for two or three years, but the preliminary work of consolidation is now being done.

There are a number of long-distance companies now doing development work and it is believed that this can be better carried on by separate companies than by one company.

* * *

MANAGERS MEET IN GRAND RAPIDS.

A conference of the managers of the larger offices of the Grand Rapids (Mich.) Citizens' Telephone Company was held in Grand Rapids recently. It was one of the semi-annual meetings of the managers, and there were twenty-two of the officials in attendance, representing for the most part the offices in western Michigan.

This meeting was called principally to discuss the work of the coming year. The sessions, which were presided over by General Manager C. E. Tarte, were given up to a general discussion and comparison of ideas. Several papers were read as to the best methods of handling the different departments of the business. Among them was one by George Stratemeyer regarding the conducting of toll lines, and another by Local Manager F. B. Newman on "Instructions to Managers." Encouraging reports were given by the visitors, all exchanges showing a healthy growth, with excellent prospects for next year's business. The managers were entertained by the local officers with a dinner at the Eagle Hotel.

The Michigan State Traffic Association of the Independent telephone companies also met recently at Grand Rapids for the purpose of considering matters relative to the long-distance business of the companies, the different ways of handling to the best advantages of interchange of business between the companies, the getting out of rate books, maps, etc. Reports regarding the business and situation in the state were most satisfactory, showing that the Independent companies are in a most prosperous condition.

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SOUTHWESTERN MISSOURI INDEPENDENT TELEPHONE ASSOCIATION.

Representatives of Independent lines in the southwestern part of Missouri and the northwestern part of Arkansas met in Neosho, Missouri, recently and organized the Southwestern Missouri Independent Telephone Association. The following officers were elected: President, C. M. Robeson, Neosho; secretary, Dr. J. B. Hancock, Newtonia. Among those present were W. T. Stahl, Siloam Springs; J. I. Potter, Gravette; K. G. Comfort, Westville; W. D. Wessons, Springtown, and others.

* * *

NORTHWESTERN INDEPENDENTS TO MEET.

The annual convention of the Independent telephone men of the northwest will be held in Sioux Falls, South Dakota, January 11 and 12. The territory covered by the Independent wires is all of South Dakota east of the Missouri river, southwestern Minnesota and northwestern Iowa. An interesting programme has been prepared and a large attendance is expected.

* * *

NEBRASKA CONVENTION IN JANUARY.

The executive committee of the Nebraska State Independent Telephone Association met in Lincoln on December 20, at which time it was decided to hold the annual convention of the association on January 18 and 19, at Lincoln, Nebraska.

The state board of railroad assessors in Kansas has fixed the rate of telephone valuations practically on the basis of 1903, the only material change being to reduce the value of instruments from $7.50 and $5 to $4.

The "Hello" Girl and "Central"

MUCH of the blame unjustly placed on "Central" for mistakes is often traced to one of the two subscribers. For "central" is always playing in a three-handed game. The calling subscriber leads out without ascertaining whether or not "central" is busy, and is utterly indifferent to the fact that she is also playing the low hand in many another deal, in which each and every player demands instantaneous action on "central's" part. Then the called subscriber takes his own time to enter the game, often necessitating a second or a third and even a fourth ring on "central's" part, all of which takes the time justly due to other callers. And then, after the game is finished and the other players have leisurely hung up their receivers, "central" must clear the boards. Suppose the calling and the called united to expedite "central's" game? What a marked improvement would be noticeable in the efficiency and economy of the service, and so much manlier a way to play this game of two against one, says a writer in the New York *Commercial.*

How to overcome the inertia displayed by the called subscriber is the problem that "central" turned over to the technical staff long ago. Millions of dollars have been spent in devising methods and equipment to facilitate the more rapid handling of telephone traffic and to simplify the work of the operator, all of which is often set at naught by deliberate lack of co-operation on the part of the called subscriber in not promptly answering the call at his telephone door just as quickly and as courteously as he would answer a call at the door of his office or his residence. Naturally this disinclination to be courteous or this exhibition of pure cussedness—call it which you will—reacts on the efficiency of "central" and aids in slowing down the service.

This same unappreciative, inert individual will make a running jump for the train at the first call of "all aboard" and if he misses the train he never thinks of blaming the conductor. But all the ingenuity that "central" can exercise will never lead him to make a running jump to answer the telephone call. And then follows a vexatious waste of precious minutes that often accounts for the language hurled at "central" and for the tying up of two lines that others desire to talk over. But the fact that he may be shutting out profits as well as persons never occurs to the inert, obtuse individual whom "central" is striving to get to the telephone.

The effect of this disinclination on the part of the called subscriber to answer his telephone promptly is mirrored most clearly in the test sheets of the largest and most comprehensive exchange system in the world. These tests show that by the expenditure of several millions of dollars in the entire rebuilding of the plants the latest approved equipment and methods were introduced. This brought about a net saving of fifty per cent in the time taken by "central" in answering a call, and over eighty per cent in the time required to disconnect both subscribers and clear the lines for others to talk over. But all this expenditure of money and time and ability wrought a saving of less than 14 per cent in the time required to complete the call—that is, to get the called subscriber to talking at the telephone.

These tests further show that during the year 1897 the average number of subscriber lines in service in one district was 17,066, while during 1902 the average number was 49,955—an increase of nearly three-fold. During the year 1897 the average time taken by the operator to answer was eight seconds; in 1902 it was only four seconds—or a saving in time of four seconds, or fifty per cent; while the average time taken by the operator to disconnect the subscribers and clear the lines was seventeen seconds during 1897 and three seconds in 1902—or a saving in time of fourteen seconds, or of eighty-two per cent.

And here comes in the astonishing fact that the actual saving in that portion of the service where the lowest efficiency had always been shown was only four seconds. That is, in 1897 the average time taken to complete a call and have the subscribers talking was twenty-eight seconds; in 1902 it was twenty-four seconds. If the called subscriber had answered promptly in each instance, it is fair to assume that the increase in efficiency would have equaled that of the operator in answering the call; that is, an improvement of fifty per cent instead of only fourteen per cent.

Yes, "central" occasionally makes mistakes. So do the employes in all other industries. And often the mistakes of the clerk are just as exasperating and expensive as those of the operator. Yet "central" usually gets the more bitter scolding. Keep a record for one week of all the telephone calls sent out, and then note how small is the percentage of errors that "central" can justly be charged with. Less than one per cent!

"Central" serves nearly fifteen hundred calls or customers a day, or from 6,000 to 9,000 a week; that is, each operator averages that number in the large exchanges. Even in the rush hours "central" easily serves all local customers on an average of three seconds each, after learning what number is desired, and not counting the time wasted by the called subscriber. Where is the clerk who can learn what a customer desires, wrap it up and hand it over, or even hand it over unwrapped, in three seconds, or at an average of twenty a minute, not counting the time the customer takes to pay for the goods? And how many mistakes would the clerk be likely to make under those circumstances?

And "central" has relatively as many details to look after as the average clerk, though the very nature of the duties precludes the possibility of "central's" enjoying a tenth of the freedom or liberty of action that the clerk has. In the large exchanges "central" faces a hundred entrances opening inward and from 3,000 to 9,000 exits opening outward. That is, "central" not only commands the full complement of subscribers allotted to her or his care, but has access through the multiple of switches or exits to every other subscriber connected to that particular exchange, and access through trunking circuits to every other exchange in the local system. And "central" must be able to instantly locate the correct door of all these thousands of entrances and exits.

Occasionally "central" does put the plug in the wrong door or switch or jack. This door measures three-eighths of an inch in diameter. The lock box in the postoffice measures at least four inches square. Yet the mail clerk probably drops White's letters in Black's box more often than "central" gives the wrong connection. And probably the dry-goods clerk sends "No. 30" for "No. 36" or black for white thread more frequently than mistakes are made by "central."

The records show that a telephone company operating 49,955 lines received during one year a daily average of three and one-third complaints, or only one complaint a day for every 15,138 subscribers; or to present it in other words,

an average of one complaint from each subscriber once in each forty-one years! And during this entire year each operator handled an average daily number of more than a thousand connections. That is, with a daily average for the entire year of 549,940 connections, there is a daily average of less than four complaints.

It is so easy to abuse the telephone operator—to vent spite and bitterness on the unseen, unknown "central," too busy or too well-trained to "sass back"—that this uncalled for and discourteous practice is sometimes indulged in by persons who would be thoroughly ashamed of their conduct if only they realized how grave is the discourtesy that they are guilty of.

Bad habits are not easily eradicated. But this habit of unjustly "sassing central" is one that any reasonable person can readily cure with the simple remedy of observing the second hands on a watch or clock and counting the number of seconds that elapse from the time the receiver is lifted off the hook until "central" answers the signal. This remedy is an old and well-tried one, familiar to all telephone officials, but the record will prove surprising to many who experiment for the first time.

Occasionally the telephone receiver is scarcely placed to the ear before the query comes: "Number?" On the other hand, now and then a delay of 30 or even 40 seconds may occur before "central" answers. But if the seconds are carefully registered each time the telephone is used during one week it will soon be seen that "central" answers all calls within an average period of from seven to ten seconds each.

And once she or he learns the caller's needs the trained "central" supplies the desired local connection in less than three seconds. That is, "central" connects the circuit of the calling subscriber through the switchboard to the circuit of the called subscriber and rings the bell on the latter's telephone, all in from two to three seconds. Of course if the called subscriber is slow in answering the ring at his telephone door the consequent delay should not be charged to "central."

Are customers waited on more promptly in any other line of business? Count the number of minutes—not seconds—that the watch records while waiting to be served in restaurant or in store, or standing on the corner waiting for the street car, or at the station possessing your soul in patience while awaiting the delayed suburban express. And what about the time lost in big department stores, so often referred to by the jokesmiths? Certainly, rapid service may justly be expected in an establishment where complete segregation of each line of goods to its own section is systematically followed out as in the modern department store. Still, how rarely these expectations are realized!

Even the butcher and the baker, the grocer and the clothier keep customers waiting minutes rather than seconds before asking: "What can I do for you?" Yet how rarely a customer thinks of "sassing" a store clerk for being dilatory or negligent or stupid, even though the indifference or the stupidity or the arrogance shown is exasperating! Why this distinction? Is it because the clerk is a living entity whose resentment will be emphatic and visible, while "central" is unseen, in a sense intangible, and because her or his reproof can be cut off by hanging up the receiver?

"Central" easily takes care of five or six or seven customers a minute. Did butcher or baker or grocer ever equal one-sixth so good a record? During the rush hour "central" has easily supplied 360 connections in 60 minutes, and under stress of intense public excitement "central" has a record of answering 15 calls per minute for several minutes in succession, or at the rate of 900 an hour.

And "central," facing a complex functional machine must serve customers with alacrity over copper threads that are often swayed hither and thither in the passing breeze, or robbed of current by the wet trees; and must select out the proper switch or jack from among thousands in a multiple board, and each of these thousands of exits measure only a half-inch in diameter. In one board where more than 3,000 exits face each operator, the diameter is reduced to three-eighths of an inch. Yet out of those 3,000 switches "central" must quickly select the one desired by the calling subscriber, while the butcher and the grocer have the solid counter, the reliable scales, the neatly-wrapped can or box to shorten and simplify the serving of customers.

Again, the snow and the sleet, the lashing of the driven rain and the lightning's flash all serve to hinder and handicap "central's" efforts to expedite the service. Then the storekeeper can utilize the stormy day to his advantage by wrapping and packing the goods sure to be called for when the sun shines. But there is nothing that "central" can store up, save it be the bitter memory of brutal remarks. Neither connections nor conversations can be wrapped up or sidetracked and handed out in moments of leisure. Whatever is called for must be delivered on the instant, if possible, or a lost connection is recorded. Is it manly to "sass" so busy and so willing a public servant?

The rush to participate in desirable bargain sales in department stores is the natural result of attractively worded advertisements, and thus it is amply provided for in the matter of additional clerks. But let a hundred customers unexpectedly enter a large store at the same moment on the hottest day in July and ask for blankets, and it is a comparatively easy matter to transfer sufficient clerks to the blanket counter to take care of this phenomenal rush and unheard-of demand; or the stock of blankets can be quickly distributed among the counters and thus expedite the sales and save much time for the purchasers.

Now, the rush in telephone calls does not come in answer to advertisements offering bargains; does not come periodically or in any specified season; does not come in quiet hours; and never sends previous notice of its coming. It arrives at the telephone exchange in the most unexpected moments, comes from the very quarter least expected and is often due to causes never dreamed of as likely to occur. Yet, "central's" customers swarm more rapidly about its counter or position and are far more insistent on being waited on instantly than ever the buyers of blankets would consider good form or courteous.

And the unfortunate part of the whole transaction is that, if these rush calls center in one position or in one section or counter of the switchboard, it is very difficult and usually impossible to distribute them among the other operators or counters or sections. As a rule, these panic rushes must be taken care of by the operators whose respective positions are the centers of swarming, frenzied callers. Had even a brief notification been sent to the exchange that a rush could be expected, provision might have been planned.

How to anticipate these unexpected panic rushes and be fully prepared to expeditiously handle the enormous increase in calls is a problem that some of the brightest minds of the country are endeavoring to solve. The modern telephone exchange is planned so that "central" can promptly take care, during a brief period of an hour or so, of a very large increase in the average hourly load or duty. Yet it is one thing to temporarily take care of three or four times the ordinary average load including the busy hours, and quite a different proposition to face an unexpected increase ten times greater than the average duty and extending over a period of many hours or even throughout several days.

Does the efficiency of the telephone operator fall off in moments of panic or of public excitement? This is a question that many telephone users probably ask when compelled to wait "central's" response in moments when actual or pending disaster makes seconds appear longer than min-

utes. The answer that experience warrants is an emphatic "No!"

In fact, at such moments "central" usually appears at her best, displaying a dexterity, adaptability and coolness that are simply marvelous. The delay in answering calls that occurs in moments when the public is frenzied by disaster, destruction or death is due to no fault on the part of "central," but to physical conditions that human ingenuity has not yet been able to relieve, although the science of the technician, the skill of the artisan and the funds of the financier have been used without limit.

Two persons—or even ten persons—might safely pass through a doorway at the same instant without noticeable discomfort. But let a hundred or more panic-stricken persons strive to force their way through an entrance at the same moment, and we have a scene that is horrible to contemplate. Yet the doorway cannot be enlarged on the instant, though such instantaneous enlargements would mean the saving of precious lives.

Now and then there are moments when it appears to "central" as if every telephone-user was striving to force an entrance into the telephone exchange through the small doorways in the switchboard. Let a catastrophe occur, like the falling of a tenanted building in the heart of the business district, a disastrous fire destroying many buildings, the wreck of an excursion train within the city limits, the sinking of a ferry or a steamer in the harbor, or the destructive effects of a tornado or blizzard—and then the front of a switchboard in a telephone exchange becomes the seat of activity almost superhuman, comparatively noiseless, almost impossible to describe, yet once seen never to be forgotten.

It is in these hours when the public appears panic-stricken that "central" shows her true colors. Occasionally an operator will "go all to pieces" in a few moments after the frightful rush begins, fall from her seat and become an hysterical burden on the more sensible operators. But such scenes are rare and are amply provided for in the large exchanges. In ninety-nine cases out of every hundred "central" exhibits a masterful coolness and an intelligent desire and keen adaptability to serve the public in its hours of trial that are simply marvelous and merit the highest commendation.

During the twenty-four hours following the Iroquois disaster in Chicago all of the telephone exchanges in that city were simply flooded with calls from subscribers whose voices keenly portrayed the fear or the agony that was chilling the heart, yet some of whom were so frenzied with grief or doubt that neither the number nor even the name of the desired subscriber could be recalled. So enormous grew the number of the incoming calls that for minutes at a time it would seem as if every subscriber in Chicago was calling, calling every other subscriber, till every line tested busy

Usually the night force in the big exchanges consists of only one-fifth the number of operators employed in the daytime. But during the three nights following the Iroquois horror the full complement of operators was on duty, not an operator's position being vacant at the main switchboards. Yet, so well-trained were these operators that they completed more connections per minute than the officials believed possible and distanced every record, notwithstanding the disheartening and exhausting circumstances under which many of the operators labored.

But no two disasters or panics affect telephone service in the same manner or to the same extent or make the same exhausting demands on "central." The victims of the Iroquois disaster came from every section of Chicago and its suburbs and, almost without exception, belonged to a class familiar with the emergency value of telephone service and likely to make large use of it under such distressing circumstances. Thus, with seemingly one accord, friends and relatives turned to "central" in the hope of gaining information regarding the fate of absent ones.

Now more lives were lost in the burning of the excursion steamer "General Slocum" than perished in the Iroquois disaster, and the homes of nearly all the victims were centered in one comparatively small section of New York city. But, from every point of view, the effect on the telephone service of this city was very different from that experienced in Chicago. None of the suburban exchanges was noticeably affected, and an appreciable increase in calls was felt in only four exchanges in the city. Possibly this may have been due to the fact that, while the loss of life was greater in the "Slocum" disaster, a far greater number of families were affected by the fire in the Iroquois.

The exchange serving the district fronting along the river or the sound near the scene of the disaster recorded the largest increase in the number of calls handled—an increase that continued during three days, yet totaled an average daily increase of only about twenty per cent. On the day the disaster occurred it was thought best to increase the day force in this one exchange by adding two operators who remained on duty till 9 p. m., of the first day only. And the regular night force was able to handle all calls promptly. In fact, the efficiency of the service has been highly complimented by those who used it during those three eventful days.

Nearly the entire increase in calls in this one exchange were trunked to or from the exchange serving district in which are located the Morgue, the department of public charities, Bellevue Hospital and certain other hospitals, or to the exchange located in the district in which the homes of nearly all the victims were located. In the latter exchange the total originating traffic was only twelve per cent greater than that of the average day. The exchange in which terminate the wires from the hospital on North Brother Island, where the "Slocum" was beached, showed a slightly increased volume of business on the first day only.

An interesting feature developed at the time of the Iroquois disaster was the fact that the telephone operators, working busily at their switchboards, had absolutely no knowledge of the causes that had brought about the great increase in the number of calls. The very fact that they were kept so unusually busy made it impossible for them to know what it was all about, as every instant of their time was occupied in finding out what number was wanted and then endeavoring to complete the connection. The first knowledge of the Iroquois fire came to the telephone operators in their rest rooms at times of relief and shortly after, when a general order was issued throughout the city that calls from pre-payment telephones (nickel-in-the-slot) should be put through without any question as to the deposit of nickels or other coins. It was of course evident from this that something very unusual had occurred, but this knowledge did not in any way impair the efficiency of the operators or their work.

The fact that the telephone exchange is the pulse of a great city is of course illustrated every day, and rushes of calls of more or less intensity are experienced, varying with the particular happenings of the ordinary daily business. Thus the busy minute in most large exchanges is between 10 and 10:15 o'clock in the morning, and this high-water mark must be satisfactorily provided for in the provision of switchboards, trunk lines and the operators to manipulate them. For many years it has been observed that if the price of wheat falls on the Board of Trade in Chicago the immediate echo of the drop may be heard in the telephone exchanges. When brokers call wildly for margins they call by telephone; when tremendous shipments of perishable fruits arrive at the docks telephones in the commission districts begin to hum before the cables are made fast. The

telephone responds instantly to all of these causes, and the hand of the well-trained telephone operator is the one which guides the call unerringly to its mark.

All during his working hours the husband has a telephone at his elbow, no matter how many employes he has. It saves him much time, a thousand steps, a score of letters, a dozen calls. It greatly increases his efficiency, enables him to achieve much that he plans, aids him in his ambition to be a leader in his chosen calling.

Why not let the telephone prove as serviceable to the wife —the housekeeper, the homemaker? Why not let its power to aid in accomplishment serve to exhilarate the wife into achievements that make life worth the living?

Granted that the husband's mother never enjoyed the helpful service of a telephone in her home. Neither did the husband's father enjoy many of the labor-saving devices that are now so helpful in promoting profitable progress. A generation ago the telephone was unknown. Housewives formerly spent much time in weaving and spinning, in candlemaking and soapmaking, though none of these pursuits is now thought profitable for home work. After the same fashion, business men formerly wrote their letters in "long hand" and kept their accounts in single entry as best they could, swept the store and cleaned the windows, though it is now thought more profitable to have clerks do this work. The complexities of life, both in the home and in the store, in the office and in the mill, the bitter competition that faces the master on every hand, and the demands that society makes on the homemaker, are such that methods satisfactory a generation ago must give way to up-to-date systematic practice.

Take the telephone away from the husband and how lost he would be without its efficient aid, how comparatively little would be accomplished, how much unfinished work would be carried over from day to day, how impotent his earnest efforts would often prove when depending for success on the prompt co-operation of others! Yet, with the telephone removed, the husband would still have the telegraph and the messenger call-box to aid him—two public service functions that are unknown factors in the problem of housekeeping; and he would have few or many employes to run hither and thither.

Only one home out of every five has even a single servant to run to and fro. Eighty-two out of every one hundred homes have no servants. The 82 per cent may be free from the exasperating annoyances that vex and worry the patience of the 18 per cent, but the 18 per cent are free of much of the manual labor that will dishearten and even enslave the 82 per cent if every convenience that facilitates rapid, systematic work is not furnished.

The husband usually follows one special calling or profession. If he supervises many lines of work, there are competent heads for each department; each department is equipped with every modern device that serves to increase efficiency and output.

The home is a place of varied industries. It has many departments. In the kitchen raw material is converted into finished products three or more times a day. On the intelligence and the experience of the head of the kitchen department largely depends the health and comfort of the inmates. Time-saving and labor-saving devices should yield profitable returns in this department. For in the husband's factory raw material may often be stored for weeks or months in advance of its use. But in the kitchen many articles must be obtained fresh each twenty-four hours, if palatable and healthful dishes are prepared. And here is where the telephone's usefulness is so obvious.

In the home is a sewing room or repair shop, where many garments are fashioned. In the home is a nursery where character formation requires intelligence, discrimination and discernment of the highest character. The telephone saves valuable time that can be devoted to cultivating acquaintanceship with the occupants of the nursery. Time is demanded of the housekeeper for receptions and other social engagements. Then the home is a library, a reading room, a place for preparatory study. At times it becomes a hospital. With all these varied departments of daily work to supervise, should the husband hesitate to place a telephone in the home, to facilitate the efforts of his wife to achieve success in her chosen calling? Is it economy to deprive the housekeeper of labor-saving, time-saving devices that facilitate rapid and systematic work?

Experience shows that the maximum average number of calls that can be promptly and advantageously handled at "central's" position during the twelve day hours is only from 1,200 to 1,500. That is, at each operator's position when filled by trained and disciplined operators, working only eight or nine hours each, and enjoying three or more intervals of rest during that period, the highest hourly average of calls that can be taken care of, is only from 100 to 125. Yet "central" is trained to sprint when occasion demands, and many times has completed an average of six hundred calls an hour, or an average of ten calls a minute, for a brief period of, say, twelve or even twenty minutes. And there are rare records of fifteen completed calls a minute, maintained for several minutes. But no human organism could stand such a strain for an hour or two, or, if circumstances stimulated it to accomplish so much, complete prostration for several days would probably be the penalty paid. But these sprinting records covering short periods of time count for little in the face of panic rushes when it appears as though everybody desires to talk to everybody else, and all in the same moment.

Hence, in assigning "central" to its position the basis on which its load is equalized is the maximum number of calls that will probably come into its position from a given number of subscribers' lines during the rush hours of the busiest day of the busiest month. Thus no two operators may find the same number of subscriber-lines terminating in their respective positions, yet both may average about the same number of calls per day, and thus carry nearly the same load.

For instance, at one operator's position seventy subscriber-lines may terminate and originate an average of 1,050 calls per day, or daily average per subscriber of fifteen originating calls. While at an adjoining operator's position the lines of only fifty subscribers may terminate, the smaller number of subscribers connected being due to the fact that nearly all of these fifty subscribers are frequent users of telephone service. For instance, forty of these lines may bring in an average of thirty-five calls daily throughout the year, while the other ten lines may not average over twelve calls a day. That would total a daily average of 1,520 calls for this operator's position, or the maximum load that good judgment would assign to a trained and experienced operator. This illustration clearly shows that while the number of subscriber-lines assigned to the first operator's position is seventy per cent greater than terminates in the position of the second operator, yet the actual work required of, or duty performed or load carried at the second position, is fifty per cent greater than is recorded at the first position. So low a number of subscriber-lines as thirty-five has been found sufficient to keep first-class operators very busy, by reason of the frequency with which the lines are used. On the other hand, there are operators taking care of one hundred and forty and even one hundred and seventy subscriber-lines that rarely average three calls a day.

In one city where a total of 19,162 telephones were connected to ten exchanges, the average daily number of originating calls per telephone was nine for the entire city. That is, each day an average of nine calls was received from each telephone in the city. To one exchange there were 6,800 business and 1,027 residence telephones connected,

with a daily average of nine originating calls per day per telephone. In another exchange operating only 978 business and 84 residence telephones, the daily average number of originating calls was fourteen.

In another city operating a total of 18,841 telephones from nine exchanges, the average was seven for the entire city. And this average daily number of originating calls per telephone was maintained by one exchange having only 169 business telephones and 527 residence telephones. The main exchange reported a daily average of nine calls from 5,729 business and 434 residence telephones. In one exchange located at one end of the city and having 1,211 business telephones and 2,620 residence telephones connected in service, the average daily number of originating calls was five, while an exchange located on the opposite side of the city and having only 456 business telephones and 333 residence telephones connected to the exchange, reported an average of six originating calls per telephone per day.

In a city where a company operates thirty-seven exchanges in its city exchange district, a total of 29,496 telephones were in operation, of which 16,916 were business telephones and 12,580 residence telephones. Here the daily average number of originating calls for the entire system was scarcely five. The total daily average number of originating calls was 141,900, and of this number 69,163, or nearly one-half, were received at two exchanges, while three-fourths of all the calls were received in five of the thirty-seven exchanges. Yet the daily average of originating calls per telephone for these five exchanges barely exceed five, which is probably accounted for by the unusually large percentage of residence telephones in service.

PROPER PROTECTION FOR RURAL SYSTEMS.

BY R. W. KEMP.

The subject of proper protection for rural systems is of as great importance as the protection of apparatus on a large exchange and should be as carefully selected and installed. A good protection for a telephone on a line not over a mile from the central office may be had by connecting up the lightning arrester furnished with the telephone, which is composed of three plates of metal (usually brass) or carbon separted from each other only slightly, the two outer contacts or binding posts to be connected to the line, while the middle contact or ground plate should be connected to the ground on metallic lines; on ground lines the right hand contact or binding post goes only to the line, while the middle and left hand contacts or binding posts go to the ground.

In installing a telephone the line wires are run to the house, usually to the top, then from the line wire run a wire not less than a No. 18 B. & S. guage weatherproof or rubber-covered wire to the telephone and the ground of the kind of wire. All contacts or connections of the No. 18 wire to line or ground should be soldered and taped so that the wires do not come in direct contact with the woodwork of the building.

Lines over a mile from the central office should have beside the arrester on the telephone, an additional arrester and fuse block. These arresters or fuse blocks are made on the same principle as the arrester on the telephone, only in addition to the arrester they have a fuse easily combustible. In case of lightning, if any of the electric fluid carried to the ground should try and pass into the telephone the fuse is consumed and throws the line to the telephone open and the lightning must go to the ground. A neat little fuse block and arrester for this purpose, instead of using a straight fuse uses what is called the saw tooth, that is, the fuse wire is wrapped around the mica strip in the shape of teeth and in that manner brings the fuse close to the ground plate, which is directly under the fuse, thus giving the lightning a chance to jump to the ground when the fuse is burned.

In securing a good ground it is well to find as damp a place as possible. Where this is not readily available a good ground may be secured by driving a piece of one-half inch galvanized pipe about six feet in the ground and keeping the same filled with water.

Too much care cannot be exercised in the proper selection of protection for the central office, and as much care should be given to the installation, as the best apparatus poorly installed is worse than the poorest properly installed. The protection for the central office that is proof against all kinds of currents is hard to find, there being on the market at the present time only two kinds of automatic fuse blocks and protectors, both of which have the self-soldering heat coils, which, when the lightning passes through them, melt and throw the line open and also make a direct contact with the ground.

The lines should be run to a pole near the central office and a protector of this kind installed on the pole. From the pole to the central office a cable should be run, and after entering the building another protector should be installed, thus making a double protector for the switchboard. The ground for the protector on the pole may be had by planting a copper sheet about eighteen inches square about five feet in the ground and a No. 10 B. & S. guage copper wire soldered to it and run to the terminal. The ground for the central office should be similar and not less than a No. 10 copper wire.

The ordinary fuse blocks and arresters as furnished by all electrical supply houses, and used by many exchanges, afford in many cases sufficient protection, but are not proof against sneak currents, and are installed the same as the self-soldering protectors.

UNCLE SAM GREATEST TELEPHONE USER.

"America leads the world when it comes to telephones," said Alonzo Burt of Kansas City, a well-known western telephone man, who returned from a European tour recently. "There is only one place in the world where there are more telephones per capita than in America, and that is Sweden, where the government subsidizes the telephone companies, so that the rates charged are much less than those in this country. The service, however, comes nowhere near that in America, nor are the telephones used so much. There is no place on earth where the number of calls per day per telephone is as great as in America.

"England is far behind America in the number of telephones per capital. London, with a population of 7,000,000, has only 60,000 telephones. New York, with 3,500,000 people, has 150,000 telephones. Chicago, with 2,000,000 people, has 100,000 telephones. You can figure out for yourself the enormous difference in the per capita ratio.

"I had an experience while I was in London which showed the comparatively small part the telephone plays in London life. H. Clay Evans, the American consul general at London, is a personal friend of mine, and so I wanted to visit him. Not wishing to go to his residence unless I knew he would be there, I tried to reach him by telephone, but found he had none. When I saw him later, at his residence, I asked him about this, and he said:

" 'It doesn't seem to be the style here in London to use the telephone.'

"Just imagine what we would think of a man in this country if he said something of this kind.

"Germany and France have comparatively poor telephone service and I think that the government ownership of the service is largely responsible for this. They don't use cables or underground service as much as we do in this country, and are generally considerable behind American standards."

Telephony in Railroad Realms

WITHIN a short time the Schenectady (N. Y.) Railway Company will install a system of telephones on its interurban system which will embrace some new ideas in telephonic communication. There will be at least four telephone stations on each line, where it will be possible for the train dispatcher in the city to signal cars by lighting a cluster of red incandescent lights upon a pole where the telephone is located. The crew of the car seeing the red light burning will stop and answer the telephone. In addition to the signal telephones there will be jacks every 1,000 feet on the interurban lines, where connection can be had with the office by the crew of a car or workmen who have a telephone set in their possession.

Each car will be supplied with a set of telephone instruments, which will have a long cord attached. Whenever the crew wish to communicate with the office the car is stopped, the cord of the telephone unwound, the plug inserted in the jack and the receiver taken from the hook, which causes a light to burn in the central office, the same as the ordinary city telephone. The telephone set may be taken from the car, or if the pole be close enough the conductor can reach out of the car door and make the connection. Only one line is necessary on each division, as the jacks are connected to the same wires as the signaling telephones. All that the operator has to do to light the signal on a telephone is to press a button. This operates a magnet in the telephone box, allowing a weight to drop, which closes the light circuit. The signal telephones are inclosed in stormproof boxes which are locked with a padlock. Connection may be made with any of the division telephones with the city system so that a conductor or foreman of a gang of men can talk with a person in any part of the city, or, if necessary, with out-of-town parties.

As the railway company already has telephone wires paralleling its interurban divisions, all that would be necessary to install the new system would be to place the jacks and signal telephones in position. Work on this will be started shortly and it is expected everything will be in working order by early spring. The officials of the company are just now considering at what points they will place the signal telephones.

* * *

The Mahoning Valley Street Railway Company, at Youngstown, Ohio, has just closed a contract for the installation of an extensive private branch telephone exchange. It is expected that the new exchange will be installed and in operation by the first of the year. A large force of men is now at work on the improvement. When the new exchange is established there will be telephone connection all along the line as far east as New Castle. The switchboard will be installed at the power house in Youngstown. The object of the exchange is to provide more efficient service. In case of trouble anywhere on the system the news can be communicated at once to the main office and in short time steps will be taken to remedy it. Besides having telephone stations along the different lines of the company these will be telephone connections at the residences of the heads of the different departments. By having such an arrangement the improvements which will surely result are obvious.

* * *

Following the lead of other trunk lines, the Lehigh Valley railroad is gradually installing an Independent telephone system on its line, for the use of its officers in transacting business with each other, but not for train dispatching. It means economy in time and expenditure. The line has been completed to Wilkesbarre, and the work of stringing wires from that point to Sayre will be finished in less than thirty days. The completion of the system from Jersey City to Buffalo will not be attained until 1906, and the installation is gradual in order that too much expense will not be involved in any one year.

* * *

The Pennsylvania Railroad Company has gone to considerable expense on its Cleveland & Pittsburg division to install a telephone system for the convenience of its trainmen, and to promote the general efficiency of its freight service. The system is rather novel in railroading and saves both time and labor for the operators and trainmen. The service is used in connection with the new telegraph block system which was placed in operation about two weeks ago, but is only used where the passing sidings are long or curved.

A telephone is installed in the telegraph tower at the beginning of a block, and within easy reach of the operator. A box containing an instrument is erected about fifty feet from the end of each passing siding whose length warrants the expense. A freight train standing on a siding has its engine within a few feet of the telephone at the end of the siding, and when the block has been cleared the operator calls the engineer and gives him verbal orders to proceed. The engineer repeats the orders and proceeds onto the block.

The sidings are arranged so that the entrance to both the north and south-bound passing tracks are opposite the tower. The length of the siding or a slight rise in the ground might prevent the engineer from seeing a signal stand, and he would be compelled to go the length of the siding to secure his orders. It is to prevent this long walk and consequent delay that the expense of the telephone has been undertaken.

* * *

The Chicago, Rock Island & Pacific Railroad is building a telephone line between Denver and Colorado Springs and Goodland, Kansas, the latter being the end of the division for the handling of trains and also for the transaction of railroad business.

* * *

Plans have been completed by the Pennsylvania railroad company for the extension of the telephone service over the southwest branch in Pennsylvania. Contracts have just been closed for the installation of three exchanges which will connect the different districts on the line between Greensburg and Connellsville and greatly aid the movement of trains in that district. One of the exchanges will be located at Youngswood, the junction point between the main line and the southwest branch, where are located the big transfer yards. It is the intention of the company to connect up all the offices at that point and give better service for the yard work. At Uniontown another exchange will be installed to take care of all the lines in the Connellsville district, where a number of branches extend into the coke regions. The exchange to be located at Scottdale will cover the branch lines extending to Everson and the Youghiogheny valley districts, including the Scottdale, Connellsville and Opossum Run branches. About a hundred miles of new wire will be required to complete the job which, when finished, will connect the offices of all the branches included on the southwest division.

Telephony.

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A SILLY SEASON OUTBREAK.

IT HAS been the general supposition all along that the "silly season" reached its perihelion in the sweltering period of dog days, when the center of the stage is occupied by the boat-rocking idiot, the hair-brained novice who attempts to swim across a two-mile lake, and others of their ilk. But it must be that the seasons are changing, or, if not, that some individuals, at least, are as susceptible to the insidious influence of the silly microbe in December as in August. If this is not the case, will some gifted genius please arise and explain the genesis and aim of the "monster $700,000,000 telephone combine" story which was given such wide publicity by the Chicago papers the first of the month, and prove to the Independent telephone public, if possible, that it did not originate in the imbecile ward out at the Dunning insane asylum. The tale certainly sounds like nothing quite as much as the vague vaporings of a man in the last stages of paresis.

The article regarding this alleged "gigantic trust of Independent telephone manufacturers" first appeared in the Chicago *Chronicle* of December 5—a paper, by the way, whose statements on telephone matters should be taken with more than a mere pinch of saline compound. We quote from the original article:

A scheme which is the preliminary step to the organization of a gigantic telephone trust which, when its alleged purpose is accomplised, will involve a capital estimated at $700,000,000 and which will put out of existence all Independent telephone manufacturing companies in the country, came to light in Chicago with the announcement that a representative of an eastern syndicate was endeavoring to obtain options on all Independent factories in the city and had obtained a few.

Similar options are being sought from all the Independent telephone manufacturing companies throughout the country with the object of forming a big combination of manufacturing telephone interests on about the same order as other large corporations, such as the United States Steel Corporation, in order to eliminate competition in this line.

While the syndicate is said to be composed of eastern bankers, it is believed among the Independent people that Bell interests are behind the movement. The latter theory, according to a well known Independent manufacturer, is based upon the fact that a similar attempt to eliminate competition was made several years ago when the Bell interests absorbed numerous Independent telephone operating concerns. This plan failed, however, for as long as there were Independent telephone manufacturers in the field, it was conceded, there would be Independent operators.

Hence the only plan by which competition could successfully be eliminated was by consolidating the various Independent manufacturing plants of the country, thereby cutting off the source of supply for the Independent operators. The movement now on foot is said to be well organized and every effort is being made to induce the Independent concerns to enter into the combination. The promoter has assured the Independents that the money necessary to put the deal through is ready, but the apparent secrecy which hides the financiers behind the deal is regarded with some suspicion by the Independents.

The options left at the various Independent companies for their acceptance are so binding that suspicion cannot be avoided. Not only are Independent people required to surrender all of their property, machinery, tools and manufacturing implements, but they also are asked to turn over all "trade rights, trade names, trade marks, labels, designs, brands, patents (granted and applied for), both United States and foreign; inventions, complete and incomplete, and every other appliance useful in connection with the manufacture, sale or use of telephones or telephonic appliances now owned or controlled by them."

W. J. Hilands of Chicago, who is said to represent eastern parties in the movement, declared that the proposed combination had proceeded so far that there was very little doubt about its consummation. Mr. Hilands denied, however, that he was directly interested in the deal, but said he has been assisting a friend. He also denied that the Bell people were interested in the plan. He also refused to state who the eastern bankers are who are financing the proposition.

The above story in substance was reprinted by all of the Chicago papers, as well as by every other daily paper of any consequence in the United States, the capitalization of the "combine," however, varying, hitting the marks of $7,000,000, $50,000,000, $70,000,000, $300,000,000, $500,000,-

000, and $700,000,000, and nearly all the points between, one enthusiastic western paper even placing the capitalization of the "vast octopus" at $7,000,000,000, which is undoubtedly the figure that should have been used in the original story, for while going after Munchausen's record and at the same time trying to out-finance Mrs. Chadwick, on paper, we cannot understand why the Chicago papers should have stopped at such a paltry sum as $700,000,000 as the amount involved in the little deal.

As a matter of fact, there is not a scintilla of truth in the report—it is a story made out of whole cloth and so preposterous and foolish as not to be worth serious consideration even for the space of a moment. As near as can be learned the whole matter originated in the action of an unknown and irresponsible party who called on the telephone manufacturers of Chicago and left "option blanks" to be filled out by them at any figure, large or small. The "mysterious stranger" never showed up for his option blanks, nor did a single manufacturer fill out or sign one of these blanks. If "Mr. Hilands of Chicago" is the man who conjured this mountain out of a mole hill, the exposé of his scheme and the utter failure of the plan to serve any purpose other than to react on the parties who were active in circulating it, must give him cold feet and a sinking sensation around the heart. By this time Mr. Hilands must be headed for the lowlands.

There is no positive and incontrovertible proof that the Bell people originated this canard for the purpose of injuring the Independent cause, but it has all the earmarks of a bungling Bell promulgation—one of which of like nature may be expected about once in so often—and the manufacturers look upon it as such, and as a characteristic but futile attempt on the part of the Bell to injure them. If this were its purpose, or if it aimed to cause the Independent manufacturers to be looked upon with distrust, it ignominiously failed. As a Christmas fairy tale it was very amusing, but beyond that it was the biggest, richest joke of the year in telephone circles, and proved conclusively one of three things—that the man who gave the dream to the press is either a born humorist, Ananias No. 2 or a victim of the "foolish powder" habit.

"SCIENCE VERSUS COMMON SENSE" AGAIN.

OUR recent editorial on this subject has caused us to receive the following letter:

Editors of Telephony.—The editorial "Science vs. Common Sense" appearing on page 503 of the December Telephony, seems to me sadly out of place in a technical journal. Almost every other article in the same number is a direct contradiction of the prevailing sentiment of the editorial utterance, and it is safe to say that not one of the leading articles could have been written without the aid of "blue prints and the higher mathematics." Were it not for these same aids, telephone practice would be to-day just where it was ten years ago and the "practical man's guess" would be fulfilling its time-honored function of leading his employer into all sorts of trouble and unnecessary expense. Were all engineers pure theorists without practical experience, there might be some excuse for the utterances in question, but fortunately such is not the case. It is doubtful if a single American telephone engineer of any reputation does not add to his theoretical equipment the results of many years' active practice in the field. I will go a step further and say that every one of these men could, if necessary, get out and do a good day's work in any department of the business with his own hands.

You take out some of the sting by saying "it is likely that the two elements are quite at peace." Here you have got your finger on the pulse of the whole matter. These two elements *are* at peace absolutely, and one without the other is little worth. Pure theory without practical knowledge couldn't build a dog kennel, let alone a telephone plant, and there could be no practical experience had not science indicated the elementary principles on which the practice is based. Pure science could not install a complicated cable system, and on the other hand all the practical men in the world could not design the cables so well described in the article in the same number by Breisig.

The trouble is that the "practical" man, like the great majority of mortals, is inclined to sneer at what he doesn't understand, even though away down in his heart he wishes that he had a little of the knowledge he affects to despise. On the other hand it must be admitted that not infrequently a "scientific" man fails to recognize the excellence of the work done by his "practical" brother and its value to him. The engineer, however, should and does stand midway between these extreme positions. To the hard "common sense" of the "practical man" he adds the "science" of the "theorist," or perhaps it were better to say the "theory" of the "scientist," and the result—well, the modern telephone plants, switchboards and instruments are the best evidence of it.

Respectfully yours,
H. J. Minhinnick.

It is one of the penalties of an editorial capacity that the sluggishness of the editorial brain and the inflexibility of language make it difficult to carry to the reader an illuminating conception of just what is in the writer's mind. In a large way we are wholly in accord with Mr. Minhinnick's mental attitude. Indeed, it seems quite likely that if all the people who are interested to think and to form conclusions about this matter were to compare notes in a logical, cold-blooded way, the difference of opinion finally remaining would be unimportant. It is probable that all would agree that it is a pity that science has to bear the burden of some public disapproval simply because there are occasional instances of people who so enjoy roundabout ways of getting at things, that they often fail to turn to nature for their facts.

It was our hope in the original comment to set down our conviction that there *is* no quarrel between science and common sense. As the conclusion seemed so obvious we anticipated no misunderstanding. As Mr. Minhinnick's letter offers a very convenient opportunity for making ourselves clear in the matter, as well as because he has expressed so well what is probably a very general conviction, we are much pleased that he has had the courtesy to make this comment.

TELEPHONE RATE JUGGLING.

THE Pennsylvania (Bell) Telephone Company recently announced to the public of Philadelphia through its presumably responsible general manager and agent, that on and after a certain date it would reduce the rate at all public pay stations within certain territory or "zones" to the sum of five cents a call, instead of the ten cents then charged. The date set for the widely advertised reduction in rates having come and gone, the Philadelphians have discovered to their disgust and cost that the Bell company did not mean what it said at all.

The city of Philadelphia is divided into "zones" under the new arrangement which it was promised should go into effect on November 1. One zone, the largest, is the territory between the Delaware and Schuylkill rivers and from League Island to Erie avenue. The promise duly announced with a flourish that all calls at public pay stations to any other telephone within that zone should be five cents instead of ten. The patrons have learned, however, to their surprise, that the charge from all public stations in hotels and apartment houses remains at ten cents.

When the local manager of the Bell was asked to explain this perplexing contradiction, he said in effect that his company "needs the money" and proposes to have it; for only a simple man would take any notice of the alleged explanation put forth, and only an impudent person would expose it to the gaze of the world. He further said that the public stations in hotels, apartment houses and the like, which the public is invited by the signs of the company to make use of, are not public at all. Does any one understand this lucid non-light-giving twaddle? The users of the Bell instruments in Philadelphia certainly do not.

And the more Mr. Manager explains the deeper he gets. It seems that the hotels are charged a large rental under

special contract for the maintenance of public stations on their premises. This rate, together with the three cents or more charged for each call and the other exactions, is so large and onerous that the hotels cannot afford to charge less than ten cents a call and "come out whole." Perhaps it would occur to an ordinary intelligence that, after the announcement had been made that the five-cent rate would and should prevail, the Bell company ought to have kept its part of the bargain by making the charge to the hotels such that they could afford to grant the five-cent call. Instead, the manager says blandly that "in all such cases the hotel is at liberty to give away its calls so long as we get our stated rate for each call made," which is the characteristic Bell way of looking at it.

When a trust starts out to be philanthropic nothing can exceed its clumsiness. From what we can understand of this peculiar shuffling, the Bell company had some idea that it would improve the telephone service in Philadelphia and was then scared by its own action.

Those who know the policy of the Bell company (and who is there that does not?) will not be surprised at its contrary action in connection with its promises in Philadelphia. It has rarely ever been known to live up to its word, and in ten thousand instances it has, by some hook or crook, wriggled out of a bad situation when brought face to face with an array of broken promises, and taken refuge behind the flimsiest of flimsy excuses, where it would sulk and growl, delectating those who opposed it, and who would call it to account, with more promises (to be broken) and with numerous polite references to that classical Vanderbiltism, "The public be d——d." It is doing business along these unbusinesslike lines that has made the Bell company the most cordially despised corporation in this or any other country, and has brought it to a point where it is forced to fight for its very existence.

And as for Philadelphia—the Keystone Telephone Company is profiting by the Bell's shortsightedness and mistreatment of the public, and is making the greatest progress in its history. Its popularity grows in like proportion as that of the Bell wanes. The people of the "City of Brotherly Love" are long-suffering, but even with them forbearance sometimes ceases to be a virtue. One of those times is right now, in the case of the Bell company.

MORE AND MORE MONEY.

THE complexity of the apparatus and general equipment of a great telephone system is something that people are just beginning to realize. The small companies, at least, which in many places have started up with small exchanges and limited lists of subscribers, generally find to their dismay that increase of business brings an unforeseen need of new capital on account of the necessity of installing the most modern appliances that must be purchased to make an extensive service satisfactory. There are now about 50,000,000 people in the United States who can get at a telephone and can talk over perhaps two-thirds of this country. Telephone development, however, has naturally enough kept evolving problems of constantly increasing difficulty as the exchanges in the large cities have grown and the saturation of the neighboring territory has gone on apace.

It is true that the telephone receiver in use to-day, with all its increased efficiency, is practically as simple as the one exhibited at the Centennial exhibition in Philadelphia in 1876; but in the transmitter that stands on the twentieth century man's desk or hangs on the wall in his house wonderful improvements have been made, and in the evolution of the present well-nigh perfect mechanism millions of instruments have been thrown away to make room for better ones. No price is too high to pay for the best possible service and any high-class organization is even more anxious than the public to have its apparatus kept up-to-date.

To-day the electric current is dispatched on a wire of copper instead of a wire of iron and is brought back on a duplicate copper wire instead of finding its way through the earth, which is generally charged with other electric currents. A wonderful economy of space has been secured by inclosing the insulated copper wires in cables, whether the lines are intended for overhead or underground structures, and the extent to which this economy has been carried appears in the fact that it is usual to have 400 pairs of wires in one lead-inclosed cable. The hanging of thousands of tons of copper in the form of thousands of miles of wire year after year is comparatively easy to understand, but in the exchange—the clearing house where the copper nerves reaching thousands of different points are under instant control a multitude of intricate and absorbing problems have been worked out.

As telephony has progressed and the use of telephones increased many fold the cost of the instruments themselves has decreased, but the investment required for the "central" plant has grown much larger. Not only is new capital required for increasing the plant to take care of a growing business, which must be accepted lest present business be lost, but a proportion of the gross earnings must be set aside for maintenance and reconstruction, since the life of telephone apparatus is comparatively short—from seven to fifteen years—and yet with all these things to contend with Independent exchanges grow apace—the increase being little short of marvelous—and of the 7,500 now in operation it is no exaggeration to say that the large majority of them find no difficulty in obtaining all necessary capital for improvements, extensions, etc., and the exchange that is not a paying investment is the exception.

A FINANCIER'S OPINION.

ONE of the most encouraging phases of the Independent telephone situation is the popularity into which Independent securities have sprung within the past year in particular, and the avidity with which these bonds are being sought by shrewd investors. It establishes in a most convincing manner the contention that has so oft been repeated in these columns, that Independent telephone securities offer the best investment in the financial market to-day, for men of small as well as large means. In the early days of Independent telephony men of wealth looked askance at the new movement and seemed to doubt that it could stand against such a powerful competitor, therefore they hesitated to become identified with it financially; but its success is a matter of history, and the developments of the past few years have proven to the erstwhile doubting Thomases of finance that there is no safer investment than Independent securities, and that none of the public-serving corporations pays more satisfactory dividends than the Independent telephone companies.

When one looks around at the hundreds of Independent telephone exchanges in successful operation all doubt as to whether or not it pays to invest in Independent securities is dispelled, and the more one investigates this matter the more thoroughly is one convinced that this field offers most unusual advantages for the man who seeks to place his money where it will bring him the largest returns.

On the subject of telephone securities, A. B. Greenshields of Philadelphia, a well-known banker and dealer in investment securities, recently issued a circular, a copy of which has been received by TELEPHONY. It contains so many good points in relation to the general question under discussion that we reprint it in full, and urge every one of our readers to peruse it carefully:

Having spent twenty-six years in the banking business, the last six in handling investment securties, I have, during that time, taken

great interest in the different grades of securities offered to the public, and how these different securities have stood the test in times of depression and financial panic. Experience has taught me, as well as others, that after government and municipal bonds, the securities issued by corporations which supply the people with a public necessity are the safest and most desirable.

The first consideration for the investor is to place his capital where it will be least affected by changes, natural and economic, in our conditions, and, if possible, to place it where it will increase in value rather than decrease. The second consideration is the interest which he shall receive, or return on the investment.

The present price of government and municipal bonds has reached the point where the interest return is very small, and for that reason, investors look to other securities for a larger return on their money. The field of public service corporations covers water, gas, electric light, steam and electric railroads, telegraph and telephone lines; and among these public utilities there are only two for which there has as yet been found no substitute. Nothing has been found to take the place of water in municipalities, and nothing has been found to take the place of telephony (communicating direct). Gas can be substituted by electric light, and vice versa, steam railroads can be substituted by electric railroads, and electric railroads can be substituted by automobiles and horsepower carriages; but for the two above mentioned, there are absolutely no substitutes.

It is, therefore, reasonable to conclude that a necessity without a substitute should always have an increasing demand commensurate with the growth of the country. The securities of water companies are well known to investors, and rarely bring a return of four per cent, while the securities of telephone companies show a return to the investor of from five and one-half to over six per cent.

Since the discovery of telephony up to the year 1895, a company controlling the Bell patents (most of which expired in that year) operated the only telephones in this country. Since then, however, Independent companies have come into the field, and the opposition has created and developed the demand for this service to such an extent that it has now become *an absolute necessity in the conduct of our affairs.* During the experimental period of twenty years or more, the perfecting of the telephone was a source of enormous expense to the original company, all of which had to be capitalized and interest paid thereon, showing that the business has been extremely profitable.

The Independent companies have been particularly fortunate in having delayed their period of activity until a time when telephone development had reached a high state of perfection. For that reason the capital of Independent telephone companies represents more nearly the investment required for the conduct of the business, and is not loaded down with what might be termed "dead capital," or capital which brings no return to the companies.

There were in operation the first of this year 1,525,167 Bell telephones, and considerably over 2,000,000 Independent telephones, showing that in nine years the Independent companies have developed and established themselves in the field to a far greater extent than the Bell company in twenty-seven years! It also shows that the Independent companies have obtained such a substantial footing that there can no longer be any thought of their going backward, as associations have recently been formed in the different states which will bring the workings of the different companies into practically one system, for the purpose of standardizing equipment, systematizing operations, and facilitating the business of long-distance telephoning, all of which will materially increase the already large earning power of the individual companies.

Independent telephone companies' bonds, purchased at present prices, will bring to the investor a larger return on his money than any other public service corporation security.

Having already shown why Independent telephone companies' securities may be classed the same as water companies' securities, the only consideration for the investor is to discriminate as to the particular securities which he may purchase. If the company is capitalized and conducted in a conservative and business-like way an investment in its securities should not only be a safe, but a very profitable one, as there is no question but that the time will come when Independent telephone companies' securities will earn the appreciation of the investing public, and when that time comes, the return on the investment will be fifty per cent less than it is at present.

Look around you at the men who had the courage to invest in the first mortgage bonds of electric street railway companies during the construction period ten or fifteen years ago. Bonds which at that time were difficult to sell at ninety cents on the dollar are in many instances to-day selling at 115 to 120. Telephone securities are at present in about the same position that trolley securities were at that time, although, to my mind, vastly superior as regards the risk of the impairment of capital invested.

So far there have been no large issues of bonds made by Independent companies, and consequently such securities have not been advertised and handled by large metropolitan banking houses that swamp the country with offerings of investment bonds. When the time comes, as it will, that these houses offer Independent telephone companies' bonds to their clients, the securities will be sold at very much higher prices, and are not likely to be as good as the "first mortgages" that are now offered.

Here is the unqualified statement of a prominent financier of twenty-six years' experience that, in his opinion, Independent telephone companies' bonds are ahead of those offered by any other public serving corporation as an investment. Mr. Greenshields is known as a conservative man, and this declaration coming from him will carry great weight with the investing public. It is the doctrine that TELEPHONY has all along been preaching, and which is now being embraced by financiers in general, of which Mr. Greenshields is a fair sample. We firmly believe that it will not be many months before Independent telephone securities will be as eagerly sought as municipal bonds and will prove vastly more profitable to investors.

THE BELL TELEPHONE CIRCUS.

DID you ever see a circus tent in process of being blown away by a windstorm? Windstorms will occur and a canvas house is not the best construction to withstand them. If the circus organization is a good one, however, the pegs which hold the tent in place will be watched by competent people, so that too many of them cannot pull up at the same time.

For a good many years the Bell Telephone Company has been conducting a circus, recognizing nothing but the standard-rate, high-priced tickets at the main entrance, and has attempted to deal in drastic fashion with those found trying to crawl under the canvas. While the weather remained fair, and the wind did not arise, the performances succeeded each other with the smoothest regularity.

But in recent times the whirling winds of the middle west have been inclined to disturb the stability of the "big-top" and we are repeatedly witnessing the amusing spectacle of seeing the tent pegs pull up in one direction after another, while the canvas hands are rushing wildly from one to another in an attempt to hold the thing together till the storm shall pass. It is probable that the amusement of the bystanders is little assistance to the effectiveness of their labor. It seems likely that a few more strong puffs will pull the whole thing loose.

UNITIES NOT PRESERVED.

THE question as to whether persons who use the telephone are in danger of receiving injurious shocks of electricity is one which naturally interests a large share of the residents of every community, and an alleged accident at Indianapolis, if the story preserved the unities, would be somewhat disquieting.

The facts as reported are: A man was standing at an office deck, which had on it ordinary portable desk telephone sets belonging to two separate telephone systems. He called the central exchange of one company, and, failing to make the connection, tried the telephone of the other system. It is supposed that the bases of the two metallic telephone stands were in contact. The subscriber says that he rested his chin on the metallic top of the first instrument tried, while he held off the receiver of the second instrument. It is related that he received a shock which caused him to fall to the floor in an unconscious condition, and that he was paralyzed from his feet to his waist, and narrowly escaped death.

Before ordering out telephones on account of the experience of the Indiana man, perhaps it would be as well to analyze the alleged conditions and bear in mind certain well known principles of telephony in the light of the facts as given. When the subscriber failed to make connection on the first instrument he doubtless hung up the receiver. In that case there was no current whatever on the line be-

tween him and the local exchange, or "central," unless it came from a crossed wire. If he had carelessly left the receiver off from its hook, there would be no current unless "central" was ringing his bell. It seems that the subscriber was waiting for a response on the second telephone, of course with the receiver off from the hook. In that case the only current, barring current from crossed wires, which could get on to his wire, would be the ringing current, if "central" on the second line tried to ring him with the receiver off, or the small and harmless talking current, which "central" would have no occasion to cut in on the ringing current; and there was no talking current, as he was waiting. The talking current is only generated by the act of talking by one using a telephone. At most, even conceding contact between the bases of the instruments, the only available current would be the seventy-five volt ringing current of one instrument, which is not dangerous.

If the man was paralyzed by electricity it could only have come from wires being crossed with wires carrying heavy currents under high potential, which investigation shows were not present. Even in that case evidence would doubtless have been left in the instruments. In other words, the story does not "preserve the unities."

AN IMPORTANT SERIES OF ARTICLES.

WE have planned many improvements for TELEPHONY to be inaugurated during the new year. Instead of making elaborate promises, we have steadily improved the publication each month and have built rather than boomed it. One improvement after another has been added, until at the present time we are publishing over one hundred pages of reading matter each issue. We have searched the field over to secure the most interesting articles, and have secured the service of the best writers on technical subjects in the world.

One of the most important features to be added during 1905 is the beginning of a series of articles by Mr. H. J. Minhinnick, the eminent telephone engineer. Mr. Minhinnick is writing a book on telephone construction, to be a companion volume to Mr. Kempster B. Miller's "American Telephone Practice." Excepting Mr. Miller's book, it will be the most valuable contribution to telephone literature we have had in years. We have arranged with Mr. Minhinnick for the serial-rights of the new book, and will commence the first installment in February. This series of articles will run into 1906, and will treat exhaustively the general subject of telephone construction; installations being divided into preliminaries and surveys, tools, conduits and manholes, pole lines, messengers and guys, cables, cable testing and splicing, terminals and protectors, line wires, spiders, cutting the exchange into service, maintenance and trouble, toll lines, batteries and power plants, tables, etc.

This is but one of the many features that will make TELEPHONY in the future, as in the past, the leading telephone publication of the world.

VALUE OF THE FARM TELEPHONE.

THE changes that have taken place during the past few years in the relation of the city to the country, and which are still in progress, are of a remarkable character. One cannot take a ride into the country and talk with farmers without realizing it. Some one will invent a means of public transportation, much cheaper than the electric roads, that will meet the requirements for getting to market, and then, with the telephone, the needs of the rural districts will be fully supplied. Already, in nearly every rural community, telephone service has been established, mainly created by the farmers themselves, and its convenience more than pays for the expense of operation.

The telephone is one of the most useful of modern inventions and for several years its utility was restricted to city use. But, like free mail delivery, telephones have become recognized as a necessity for rapid and economic communication in rural as well as urban communities. Where it saves the city business man a trip on the cars and valuable time, it relieves the rural patron of the trouble, time and expense of harnessing a team to deliver a message two or three miles distant. It saves a multitude of trips to town, which take time and involve incidental expenses. In the busy season errands are quickly negotiated without extra wear on the team or the farmer. It often saves a year's expense by having the use of the telephone for one day.

On a recent visit to the country a team ran away and the owner notified his neighbor by telephone, who stopped the runaways before they had done any damage to themselves or the vehicle. This one instance probably saved the cost of the telephone for several years. The telephone has become one of the indispensable conveniences of rural life. Telephone service is rapidly extending in agricultural districts. It is reported that Indiana has 25,000; Ohio, 22,000; Michigan, 18,000, and all the western states are extensively adopting telephone service. County lines are arranged to connect with a central switchboard, so that long distance messages can be transmitted.

Farmers who patronize telephone service regard it as a good investment. It brings them into direct communication with all the members of their locality. The farmer is in easy conversational distance with the county seat and can order a bill of goods or call the doctor, send out invitations to a party, or find out the news of the neighborhood without leaving his house. If he wants to keep in sympathetic touch with the market there is no medium that excels the telephone. He can thus contract for future delivery of his vegetables, poultry, butter and eggs without loss of time. It is almost indispensable in the busy season in arranging for the exchange of help. As a rapid and easy medium for the transmission of important news the telephone has no equal and farmers are showing their appreciation of a good thing by adopting it generally.

EDITORIAL ETCHINGS.

Independent telephony the coming year will experience the greatest boom in its history.

An exchange run on a "cheap John" plan generally receives "cheap John" recognition from the public.

Some people who are fighting the Independents don't seem to profit by experience. "A burnt child dreads the fire," but not "some people."

The day when the telephone will be so cheap as to become as much a necessity in every house as water, light and heat is nearer than most people anticipate.

"For ways that are dark and tricks that are vain, the heathen Chinee" isn't alone Commend us to the "frenzied financiers" representing the "natural monopoly" wing of telephony.

There is no more reason for some central company owning all the electric light plants, gas plants, water companies, street car and steam railway systems than for some giant corporation controlling all the telephones in the country.

The Independent telephone movement was organized to take care of the demands of the people for a fair, adequate and modern telephone service, which mission the Independents are admirably fulfilling.

QUESTIONS AND ANSWERS

Conducted by J. C. Kelsey, Purdue University, Lafayette, Indiana.

What particular object does the 500 ohm coil serve in the standard private branch exchange cord circuit, as shown in Fig. 1?

The standard private branch board of the Bell companies and most of the Independent companies makes use of a combination cord circuit. A combination cord circuit is one which will connect the private branch subscriber to a trunk line, and cause energy to be furnished from the main exchange battery. This is accomplished by means of the sleeves of the jacks and plugs. The sleeves of the plugs get battery from the negative side through the relay numbered *76A*. If the sleeve of the jack is grounded, or connected to the positive side of the battery, the relay *76A* has a path for the current, is energized, and the No. 20 retardation is removed at contacts *a* and *b*, and the cord circuit simply acts as a clean metallic circuit from the subscriber to the main exchange. On local connection, the subscribers have to be furnished battery, hence the sleeves of the local line jacks are left open, and plugging in will not affect relay *76A* in any way. In private branch work it is desirable when the operator leaves that a chosen few of the private branch subscribers shall have direct exchange service with their main office. To accomplish this, it is desirable that relay *76A* clear the circuit entirely, which normally it does not, as relay *76A* only puts a bridged impedance of 500 ohms across the line, not enough to interfere with

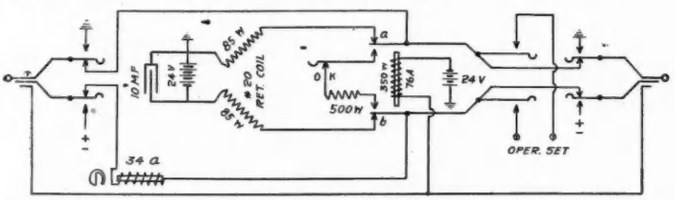


FIG. 1.

transmission, but enough to give the operator control of the disconnect signal, which would ordinarily be given by the subscriber himself. But at night, when the operator leaves, she plugs up the favored lines into the trunk jacks and turns the key *K* in such a way as to open the circuit of the 500 ohm bridge at point *o*, thereby allowing the subscriber to have through connection. If the 500 ohm bridge were left the line signals at the main exchange would be permanently lighted and the subscriber cut out of service entirely. Just whether it is most desirable that the operator shall control the disconnection of private branch calls is not absolutely settled, and the use of the bridged impedance with a key makes it optional with the operator. It is the bridged impedance that enables her to call central without the aid of a subscriber's line with the instrument receiver off the hook. If a party called up and asked for central without giving the branch operator the desired number, and let her call him when ready, she could simply insert the plug in the trunk jack, and central could be called without the 500 ohm bridge. When the party hangs up, the relay *34a* signifies the fact simultaneously with the main exchange signal. Supposing that the main exchange operator pulled out her plug and another operator is seeking the trunk. Finding it not busy she will plug in and ring. Who will she call? Not the exchange operator, but the subscriber who has not yet been disconnected. So you see, if the 500 ohm bridge is left on the circuit, the main exchange gets no disconnect signal until the private branch operator wills it. The 500 ohm bridge is the controlling factor.

Why is the *85A* relay bridged across the clips Nos. 2 and 3 of the No. 20 induction coil, instead of Nos. 1 and 3, and including half of the coil in the ringing circuit?—B. K.

Figure 2 is the four-party selective ringing circuit of the Bell telephone company. In the early forms, the pulsating currents passed over the respective side of the line through a biased bell to ground. The biased bells were permanently connected, and soon it was noticed that the lines became noisy, especially when paralleling the rails of a trolley line. To obviate the effect of these earth currents passing

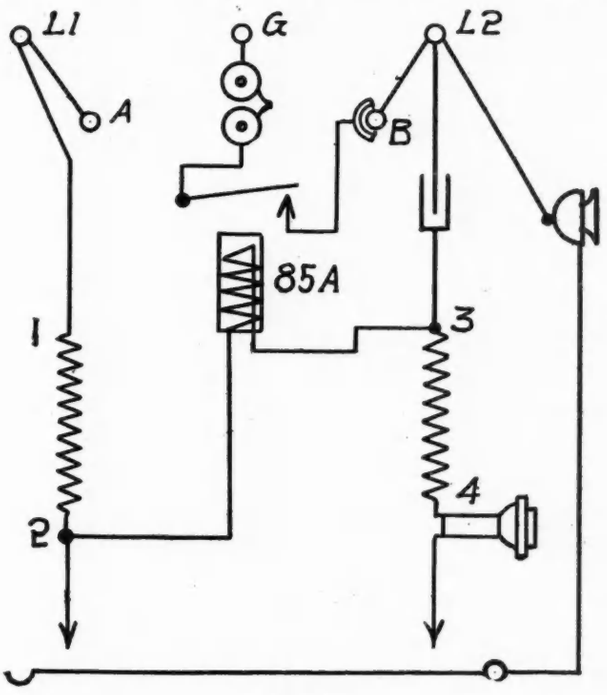


FIG 2.

through the circuit, which reduced the metallic lines to a mere grounded service level, it was arranged to cut off the grounded bells and have them connected to ground, only when ringing current passed out on the line. Looking at the figure, the middle post *G* connects the bells to ground, when the contact of relay *85A* is closed. Supposing a pulsating current passes out on the line into the instrument at *L2*. A pulsating current passes through a condenser readily, hence a current passes through the condenser and the *85A* relay back to the central office over line side *L1*. This current is alternating in character, and as the relay *85A* is designed for alternating currents, it will close its armature contacts while the current is flowing. The current will divide, and most of it pass through to ground through the bell *B*. The bell *B* has a resistance of

2,500 ohms, and has to develop energy enough to overcome the tension of adjusting springs. Therefore, they avoid taking away much of the energy by making the current through *85A* comparatively feeble. The *85A* has 2,400 ohms, the condenser might be said to have 5,000 or more ohms, and the secondary of the induction coil has but 30 ohms, yet its impedance is very high, and it helps to deflect most of the current through the bells proper. The bells will ring with contacts *1* and *3* in use, but *2* and *3* make a better combination. At their best, the adjustment is precarious, but from the quiet operating standpoint the *85A* is very effectual.

In using what is called a standard wire chief's desk No. 2 for testing lines, I get the following freak reading at times when the inside wire is wet but not grounded. I test the line for ground on one side, and find it clear; I then test it on the other side, and also find it clear. Then I test it for short-circuit and find it showing some resistance, getting a few volts, which does not amount to anything, as the cord will dry out. But when I use the ground, volt and reversing key at the same time, the scale increases gradually, instead of decreasing, as it does when the line is tested for a short-circuit. Now it appears that when the line is tested for a short-circuit, and the scale decreases, the drying out effect of the scale is indicated, and when all three keys are used at the same time, the increasing scale would show a break down in the insulation. But why and how?—K., Missouri.

The arrangement is as shown in Fig. 3. It is certain that a decreasing scale indicates a drying out, or increasing resistance, and that an increasing reading denotes a decreasing resistance, showing a break-down tendency. I have no solution to offer at this time, and will leave it to the vast army of efficient wire chiefs to solve.

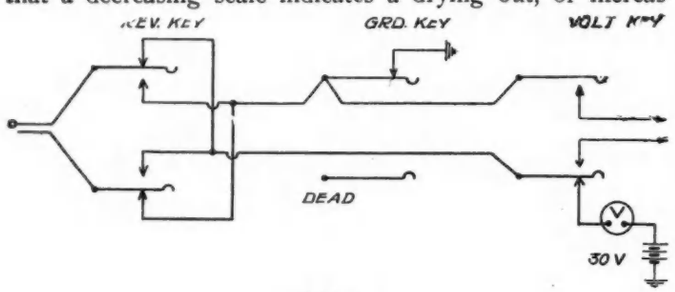


FIG. 3.

In placing condensers in local battery telephones, to prevent weakened ringing by reason of rubbernecks, where is the best place to avoid lightning? Would it not be better to place the condenser between the receiver and the induction coil secondary?—M., Indiana.

A telephone receiver is not a very efficient impedance in the path of lightning or charges from lightning. It looks reasonable that the induction coil would serve to protect the condenser, but if the charge is heavy enough to puncture the coil, the condenser will not stand much chance. If the instrument had arresters with good grounds, it is certain that the charges would pass through the easy path to ground in preference to the soil. It might be said likewise with the receiver. If the line is a grounded circuit, it would certainly be advantageous to have the condenser next to the ground, protected by both induction coil and receiver. Charges likely to break down a condenser might be deflected by the carbon arresters, providing they are not too far apart. On the whole, it is foolish to speak of protecting a condenser with other vital parts. The safety of induction coil is of much more importance; likewise, the receiver. Lightning charges have so many vagaries that one cannot predict much of certainty. It is a good plan to have protectors of some standard make.

I built an exchange three years ago, in a country town in Iowa with 900 people, with switchboard and pole lines calculated for 100 capacity, rates $1.50 and $1. Farmers build and equip their own lines, and pay expense of bringing wires from city limits to the office, and pay 25 cents a month for each instrument on their lines. After allowing for depreciation and interest on money invested, the system has earned a good profit. Of late the people seem to have gone telephone crazy. Every drop is taken, we have put two or more on a line whenever possible, our cross arms are full, and there are a number of town patrons and farmers still clamoring for service. What is to be done? Will it pay to go to several hundred dollars' expense to provide a new switchboard, additional poles, etc., or must we put off our would-be patrons until some one dies or moves away, for that seems to be the only way we can have a drop vacated?—E. O. C. Company.

I should certainly advise: Be game and build. If your pole line is crowded, get a cable, and put the long lines through it, and handle the town business with the open wires. You can handle another 50 or 100 subscribers just as easily as you handle the present list, and add more to your revenue than to your expenses. It is hardly consistent with the old cry of service for the people. It is the strength of the Independent movement, the tendency to serve all classes. There was a time when only a few people could secure telephone service, without signing their rights away. In these days it should be understood that a franchise should be forfeited when the company refuses to serve a patron in the districts of that town's authority, so long as they are sure of his ability to pay the established rate. It is the duty of the E. O. C. Company to enlarge its plant and take care of the waiting business. By enlarging the plant, and with more subscribers secured, the service is that much more valuable to the subscribers. Supposing that you spend $1,000 in rebuilding, or putting in additions, and secured eighty mixed contracts at $1 and $1.50, or an average increase of $100 a month, or $1,200 a year. The interest at six per cent is $60, and supposing you allowed as much as eight per cent depreciation, you would have $1,060 annually to apply on increased operating expenses and surplus. The increased operating expenses would not be more than one operator at $20 a month, which would leave $820. The cost of maintenance would amount to ten per cent of $1,000, or $100 yearly to make necessary repairs, so that the depreciation of the plant will not amount to more than ten per cent. By proper maintenance, the depreciation of the plant could be held down to five per cent. It costs a great deal more to repair a house after ten years of hard usage than it does if good, moderate repairs have been made from year to year. By putting in ten per cent maintenance charges, or $100 on good repairs each year, the life of the plant will be considerably increased. This would leave $720 for surplus or dividends. As you have to look after only a 100-line equipment now, the chances are that there is a little leisure time, which could be put in on the care of the new work, which will be simply a switchboard, instruments and a new cable, none of which takes much time. It is the old story of the Independent workers, that their wildest dreams of subscriber lists have been exceeded by 100 per cent. I am not saying that eighty new stations with line facilities can be installed for $1,000. I am only assuming that on the strength of the question which suggests the expenditure of several hundred dollars.

We have a little telephone system of 250 telephones, which we installed at a cost of $10,000. Last year we earned something like $4,900. It cost $2,400 to run it, which includes the wages of three operators, manager and trouble man, supplies, rent, light, etc. Some members of the company seem to think that the $2,500 should be paid out as a dividend. I would like to have depreciation, maintenance and such terms explained, so that I may inform the members of the company. What should be done with the $2,500 left over?—J. M. S., Indian Territory.

While I am not an authority on this peculiar topic, I will tell you one of the many ways which it has been told to me. It is agreed that eight per cent is a fair dividend, and should be paid quarterly for its good effects. Subtracting the dividend of $800 leaves $1,700 in the treasury for fixed charges. One man has said that when a plant is paid for, there should be fixed charges sufficient to re-

build a new plant at the end of a fixed period, by reason of the old one being obsolete, rather than worn out, to repair it sufficiently to keep it in the best of running order to the end of the fixed period, without a cent of cost to the original investor, or any change in the fixed dividend.

Suppose you own a house, which cost you $2,000, and which rents to a good, paying tenant for $300 a year. It is in a desirable neighborhood, but there is a time coming when the house will not be in demand, because the neighborhood is growing undesirable. If the owner takes five per cent for interest, sets aside five per cent for depreciation and pays out five per cent for maintaining the house in the best of repair, he will retain his tenant twenty years, get the benefit of five per cent interest and have $2,000 set aside to buy the tenant a new house in a more desirable neighborhood. If the five per cent maintenance charge has been carefully expended, he will have a house just as good as new, which could be sold to persons not objecting to the neighborhood, and at a good price, too. But had the owner not expended the maintenance fund, he would have lost his desirable renter in a short time, and the tumble-down house would not bring any price, either.

This compares to the telephone business. If not kept in good repair, the subscribers will become disgusted with the bad service in a very short time, and change to a more desirable service. I have seen telephone plants with pole lines that had been standing eighteen years and still good, with a local battery system of apparatus which had done service for eighteen years, and is still doing service in outlying districts. This would indicate that depreciation should be five per cent or less. According to wear and tear that would be true. But the neighborhood changes, or, rather, conditions change, and the system has become obsolete before it has worn out. In this period of telephonic development it has been satisfactorily proven—to me, at least—that the period of a system's usefulness will not exceed twelve and one-half years, or an eight per cent basis. If you set aside eight per cent of your investment for a depreciation charge, you will have $900 left for other purposes. If the $800 depreciation fund is put on compound interest considerable revenue is available, which can be put into a surplus fund, to meet unexpected storms, acts of Providence, etc., if the maintenance fund could not meet it.

In addition, there should be a fixed charge for maintenance, which means the fund that can be reasonably expended in making repairs, guying lines, pulling out defective pieces of construction, and rectifying mistakes of first construction. If an eight per cent maintenance fund is reasonably and judiciously expended, the plant will be kept in good order, the service kept up to standard, and throughout the entire term of 12½ years the plant will look so well as to excite regret for making the inevitable change due to changed conditions. But the plant and apparatus has been so well taken care of that it is still valuable to someone who is not confronted by the changed conditions, and a very advantageous sale can be made. This eight per cent fund for maintenance need not be expended yearly from the first, but can be saved to meet the increased decay of the later years. It is well not to exceed the eight per cent, for if it is done it will indicate extravagance, because it is certain that in twelve years a plant need not be rebuilt more than once. If the eight per cent is expended you will have a surplus of $100.

There is just as much reason for a fixed maintenance charge as there is for a depreciation charge. If you allow nothing for maintenance, you are storing up a world of trouble when the depreciation percentage is found to be three or four times what you estimated. By spending money on repairs you can fulfill the depreciation estimate exactly. If people will estimate the obsoleting of certain parts of their plant, and not the estimate of how long it will take to wear out and become useless, they will come nearer to exactness. For my part, whatever is taken, it is well not to estimate lower than on a 12½-year basis. That is a long time, for conditions change, thoughts change, experiences teaches newer and better things, and man is of few days and full of trouble.

What is the principle of the automatic ringing done by the Bell company on its trunk circuits? When the party answers, the ringing stops and the key at the central office jumps back to normal.—J. S. E., Colorado.

The automatic ringing is done by a key, which is depressed and held by a catch, which causes the ringing current to pass out on the line through the subscriber's condenser and ringer. As both of them have a comparatively high resistance to alternating currents, the current flowing will be very small. In connection with the key is a magnet, through which the ringing current passes on its way to the line. The magnet will not attract the armature of the key cam, owing to the feeble current passing. When the receiver is removed from the hook, a new path is given for the currents, much lower, as the transmitter and the induction coil secondary have less than 100 ohms resistance, which makes the control magnet strong enough to draw the cam from the distended springs, which allows the key to assume its normal position, and close up the talking circuit. The resistance of the condenser and bell runs up into thousands of ohms, while the circuit with the telephone off the hook has so much less resistance that the sudden rush of current acts instantly, and you see the key cam spring back to normal.

GROWTH OF HAMILTON HOME TELEPHONE COMPANY.

The December report of the Hamilton Home Telephone Company of Hamilton, Ohio, shows what active, intelligent business management with a local directory of good citizens can do, notwithstanding the lack of toll line connections. Hamilton is about thirty miles from Cincinnati, where a majority of the people do their trading. The Cincinnati Suburban Bell Telephone Company owns and operates a local plant at Hamilton, furnishes four-party-line service at $1.25 per month and is a very active competitor.

The Hamilton Home Telephone Company opened its first exchange January 1, 1903, and on December 21, 1904, had 1,600 telephones installed and connected with their city exchange, and four exchanges in Butler county, making 2,000 telephones altogether in Butler county. The company charges $30 for business and $18 per year for residence telephones and has no party lines in Hamilton. In the country it charges $15 per year for service on a six-party-line, requiring all subscribers who live off the main line to pay the cost of installation and keep the side line in repair. It pays quarterly on its common stock and has a surplus on hand besides. Its board of directors are successful business men who believe in good equipment, good service and good

The company has a first-class plant in every respect and

The company has a first-class plant in every respect and is fortunate in having as its manager one of the best known men in Independent telephone circles, W. Gilbert Thompson. Since Mr. Thompson has assumed the active management of the company he has already increased the large list of its subscribers over 200 and its toll receipts over 200 per cent; he has adopted a system of lines that eliminates free service to non-subscribers, and has the hearty support of its various patrons in its enforcement. The stock of the company is in demand as an investment and is finding a ready sale in the local market.

Paper telephone poles are among the latest developments of the art of making paper useful.

In the Financial Field

CUYAHOGA TELEPHONE COMPANY'S FINE SHOWING.

THE showing made by the Cuyahoga Telephone Company of Cleveland for the past eight months, or since the new switchboard was cut over, has been unusually good, and the gain in new telephones and in earnings is more than could have been reasonably expected. The new switchboard was cut over on March 5, 1904, and from March to October, eight months, the net gain in new telephones was 4,641, with a gain in gross annual earnings of $123,663. The average number of new telephones installed per month during this period was 580⅛, and the average monthly increase in gross annual earnings was $15,585.37½. The net gain in new telephones from November 1 to November 23, twenty working days, was 646 telephones, with an increase in gross annual earnings of $17,472. This indicates that the gain at the present time is a great deal more than the average gain for the eight months.

If this increase was kept up throughout the month of November, and there is every indication that it was, the increase in telephones for the month would be 817½, or an addition to the gross annual earnings of $21,840. This is 237⅜ telephones and $6,254.62 above the monthly average for the past eight months. The average for the first twenty-three days of November was 32.3 telephones, or gross annual earnings of $673.60. The number of contracts made on the last day of November was sixty-five telephones and gross annual earnings of $1,713.

Where is the telephone company in the land that can beat this?

MASSACHUSETTS TELEPHONE AND TELEGRAPH COMPANY.

The Massachusetts Telephone and Telegraph Company, an Independent organization, doing business in Boston, has filed its statement of financial condition up to November 15, 1904, and compares as follows:

Assets:	Nov. 15, 1904.	Nov. 4, 1903.
Cash and debts receivable	$25,676	$22,275
Construction and rights	24,116	23,739
Balance profit and loss	.....	91
Total	$49,793	$46,105
Liabilities:		
Capital stock	$10,000	$10,000
Debts	39,680	36,105
Balance profit and loss	113	.....
Total	$49,793	$46,105

The Boston & New York Telephone and Telegraph Company owns 80 of the 100 shares.

UNITED STATES TELEPHONE BONDS TO BE SOLD.

One of the big deals on hand for this year in the telephone securities market is the sale of about $2,000,000 United States Telephone 5s. Owing to the policy of the Everett-Moore syndicate these bonds have never been sold except on the Cleveland Stock Exchange, and a great many of them are still in the hands of the original purchasers. The Federal Telephone Company owns a big pile of them, as do members of the Everett-Moore syndicate. Despite the fact that they have not been absorbed by the Cleveland market they have increased in value over 10 points during the past year and are now in active demand around 70. They are undoubtedly one of the best telephone bonds in the country, either Bell or Independent, and with the relief of the Everett-Moore syndicate from its troubles will undoubtedly sell at a better price, even if no attempt is made to pool them. It is understood, however, that shortly after the first of the year all holders will be asked to pool them for a sale to eastern interests and it is likely that the price in Cleveland will advance to at least 80. It is proposed to sell them at a price of 85 or better, and even during the past year the syndicate has had offers for them slightly under 85.

BRIEF FINANCIAL NOTES.

The Kingsley (Iowa) Telephone Company has increased its capital stock to $15,000.

The Centralia (Mo.) Telephone Company has increased its capital stock to $30,000.

The McKinney (Texas) Telephone Company has increased its capital stock from $20,000 to $30,000.

The Citizens' Telephone Company of Battle Creek, Michigan, has declared a semi-annual dividend of four per cent.

The Grangers' Mutual Telephone Company of Fisher, Illinois, has increased its capital stock from $15,000 to $20,000.

At the annual meeting of the Ottawa County (Ohio) Telephone Company the usual dividend of 3½ per cent was declared.

The Belmont Telephone Company of Wheeling, West Virginia, will increase its capital stock from $75,000 to $150,000.

The Valley Telephone and Telegraph Company of Green Bay, Wisconsin, has increased its capital stock from $200,000 to $250,000.

The Mutual Telephone Company of West Stockbridge, Massachusetts, has declared a dividend of seven per cent on its past six months' earnings.

Stockholders of the Nicollett (Minn.) Telephone and Telegraph Company have purchased the St. Peter telephone system of James Bennett for $95,000.

The Madelia (Minn.) Telephone Company has declared a dividend of six per cent, the second in the twelve months which the company has been running.

C. F. Haworth of Danville, Illinois, has transferred his stock in the Vermilion County Telephone Company to William Henderson of Ridgefarm for $29,500.

Twenty-five shares of stock of the Home Telephone Company of Fort Wayne, Indiana, recently changed hands at 39, being the record for sales of this stock.

At the annual meeting of the stockholders of the Orange Telephone Company, held in Fredericksburg, Virginia, a dividend of six per cent was declared on the stock.

Directors of the Strowger Automatic Telephone Company have declared the usual dividend of 50 cents per share for the quarter, payable January 2 to stock of record December 22.

At a recent meeting of the Northfield (Vt.) Telephone Company a reorganization of the company's stock was effected, and it is reported that about 2,200 shares will be issued.

It is now reported that the Commonwealth Electric Company of Philadelphia has bought the entire conduit system of the Keystone Telephone Company for $3,000,000, and

that it will establish a competing electric light plant throughout the city.

The Greenleaf Telephone Company of Blue Rapids, Kansas, owned and operated under the direction of Dr. A. Armstrong of Greenleaf, has been purchased for $12,200 by a stock company.

The October statement of earnings of the United States Telephone Company of Cleveland showed an increase, gross, of six per cent and a net increase of 9.6 per cent over the similar period last year.

The directors of the Tri-State Telephone and Telegraph Company of Minneapolis have declared the sixth quarterly dividend at the rate of 6 per cent per annum on the preferred stock of the company.

The Michigan Bell Telephone Company has given a mortgage to the Old Colony Trust Company of Boston. The mortgage is to secure the payment of $10,000,000 gold bonds, and runs for twenty years.

All the subsidiary companies of the Federal Telephone Company made a gain for October over last year. The Cuyahoga made the best showing, the gain in gross earnings being $7,000 and in net earnings $3,500. The company also made a reduction in fixed charges and increased the surplus for stock.

The Belmont and Pleasant View Telephone Company of Belmont, Wisconsin, by Frank T. Hinkins, president, and John Hillory, secretary, has filed an amendment changing the value of the shares of the stock from $50 to $25, and increasing the number of shares from 100 to 200, leaving the capital stock the same, $5,000.

The Home Telephone Company of San Diego, California, has expended $52,398.88, as against $30,000 which it guaranteed to spend when granted its franchise, the expenditure being divided as follows: For labor, $15,534.84; material, $36,864.04. According to the franchise $30,000 was to be spent in the second period of the grant, which was from the eighth to the twelfth month.

At a special meeting of the stockholders of the Union Telephone Company of California, Pennsylvania, it was the unanimous vote of all stockholders present to increase the capital stock from $15,000 to $20,000. Statements were made showing a net earned balance of $756.05, the period covered being the first eleven months of the company's business, which was considered a good showing, as it not only includes the starting months of the company's business, when only a few telephones were installed, but it also includes $933.75 paid in dividends to stockholders during that time.

PITTSBURG AND ALLEGHENY COMPANY BRANCHES OUT.

Following out the aggressive policy which it established in the beginning, the Pittsburg and Allegheny Telephone Company has arranged to enlarge its scope of operations by the erection of an exchange building in Knoxville, a suburb of Pittsburg, which will be equal to any similar structure in western Pennsylvania, and will cost at least $20,000. The work of excavation has already been started and the building will be finished in about ninety days.

In its design and arrangement the Knoxville exchange building will be very similar to the one recently completed by the company in McKeesport. The part that is to be erected now will be 35x75 feet in dimensions. To provide room for future growth the company has wisely bought 40 feet in the rear of this, on which the new building can be extended at any time desired. The building will have walls of pressed brick with white terra cotta trimmings, and will be strictly fire-proof. A well-finished basement will extend under the whole structure. The architects have adopted a special design for the building to indicate by appearance the purpose for which it was intended.

The exchange is intended primarily for long-distance service, twenty-two positions being provided on the long-distance switchboard. In addition to the long-distance switchboard space is also allotted for a 3,000 line multiple common battery swichboard for serving the company's patrons in the territory immediately surrounding the office. It is proposed to equip this office in the most modern manner for handling both long-distance telephone and telegraph service. All calls from points west of Pittsburg and those destined to points east of Pittsburg will be switched through this office over lines which skirt around Pittsburg. In fact, all the long-distance service will be kept out of the city lines entirely, except when a call is made for a subscriber in the city when the connection will be put up over special long-distance trunks. When this exchange is in full operation it will not only greatly relieve the present strain on the company's service due to its marvelously rapid growth, but will afford to Pittsburgers and their outside friends by far the best means of long-distance communication that they have ever enjoyed.

The interior of the exchange building will surpass any similar building in the city. The offices will be handsomely finished in hard wood and will have tile vestibules. Special provision has been made for the comfort and health of the operators. Dainty lunch rooms, a retiring room and a large reading room will be supplied. The latest and most improved system of heating and ventilation is to be installed and the lighting will be secured by an adequate distribution of skylights and windows.

"MANDY'S TELLYFONE."

BY LUELLA WILSON SMITH.

Folks gone out a-callin', an' I'se all alone;
Guess I'll talk to Mandy frew de tellyfone.

"Hello, Central! Howdy? Gib me sixty-two;
I wants Mandy Willyums, Canton avenoo.

"Hello! Dis you, Mandy? Don't yo' know my v'ice?
Dis yer own Mose Johnsing. (My! but dis is nice).

"Your hello's as natchul—jes' de sweetes' tone—
Convuhsashum's pleasant frew de tellyfone.

"I would like yo' comp'ny foh nex' Satuhday,
Down to Mistah Jacksing's—tell me right away.

"Dar's to be a cakewalk—reg'lar big swaree—
Got my razah sha'pened. Will you go wid me?

"No one 'round to hear us, 'ca'se I'se all alone.
If yo' lub me, Mandy, tell de tellyfone."

Foh de Lawd-a-Massy, what you 'spose she said?
"Can't stan' here a'talkin' to no woolly-head!"

Den she ring dat bell up right in my bes' ear;
Made me jump an' holler—felt so mighty queer.

Feel it yet a-buzzin', an' it makes me groan;
Golly! Dat jes' awful—Mandy's tellyfone.

My tin-pan's done busted, I kain't hear a tone;
Didn't s'pose folks killed yo' frew de tellyfone.

Now heah comes de Missus—guess I'd bettah fly.
"Good-bye, Mandy Willyums; my haht's broke—good-bye."

The first wireless message from the Kansas City station of the American De Forest Wireless Telegraph Company's office was sent to St. Louis December 8 and verified by long-distance telephone. The company opened the office for general business. There is also a station building at Sedalia. William Howard Fennell, who is in charge of the station at Kansas City, has gone to Cuba, where the Detroit company has a government contract for installing a system.

Local or Hand-Made Cables

W. A. FRICKE.

ONE of the many important features in telephone engineering is that of cabling, and one which appeals least to most telephone engineers, especially when laying out apparatus to be installed in a switchboard. Usually the engineer locates his apparatus as he think best, regardless of the fact that the same will have to be cabled in some manner.

If the telephone engineer of to-day would bear this in mind, an improvement in cabling would be very certain. A few of the following suggestions might help us to obviate this thoughtlessness to some extent, and as they have been already practiced by some engineers they are practicably reliable. First, in locating keys, lamps or signals of any kind in a keyshelf, arrange them so that the first key, lamp or signal to which you cable is equi-distant from the edge of the key shelf in each position. Secondly, arrange the cord fasteners in the rear of the board so that they will have the same relative location in respect to the cords in each position with which they are associated. Thirdly, place supervisory relays, punchings, etc., on the relay frame and connecting racks on the rear of the board so that each position may be wired exactly alike. Fourthly, such apparatus as induction coils, retardation coils, generator lamps,

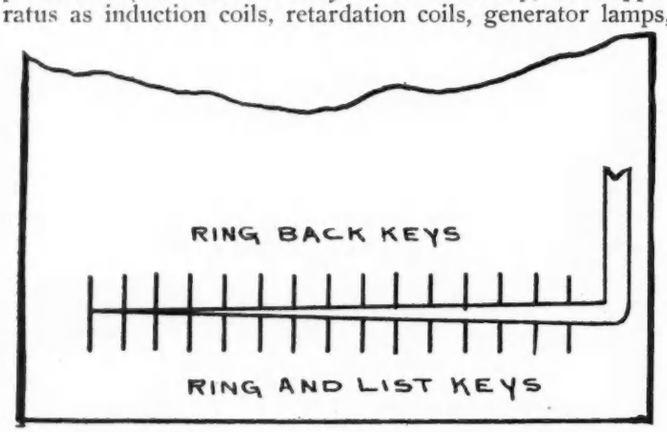


FIG. 1.

binding posts, etc., can, in most instances, be located in the roof or frieze board of the section, and laid out in such a manner that the apparatus will wire up the same for each position. If the above conditions are followed out, in most instances, a hand-made cable laid out for one position will conform to any other position similarly equipped.

When two sets of keys are used, such as listening keys and individual party line ringing keys, or any other combination, it is well to lay them out so that a cable arm can be run between the keys, as shown in Fig. 1. If space will not allow an arm to run between the keys, an arm or arms may be run around the keys, as shown in Fig. 2. Fig. 3 shows us a cable where it is impossible to run an arm either around or between the keys, owing to the fact that the keys in the keyshelf take up nearly all the space in this case the cabling has to be made up as shown in the figure, in which the arm runs alongside of the supervisory lamps and is fed through the keys.

One should be very careful in locating apparatus in a switchboard so that the same may be readily wired, taken out for repairs, or inspected.

We have now learned that neat cabling is due somewhat to a systematic laying out of the apparatus. Now let us see if we can do justice to a well equipped board by wiring it up in a neat, workmanlike manner. Before beginning we must be able to picture a switchboard with its apparatus as though it were on a plain surface. Then begin from the front, starting at the keys, wiring order wire keys, if any, then extending our arm back to the supervisory lamps, or signals, etc., as the case might be, running back from

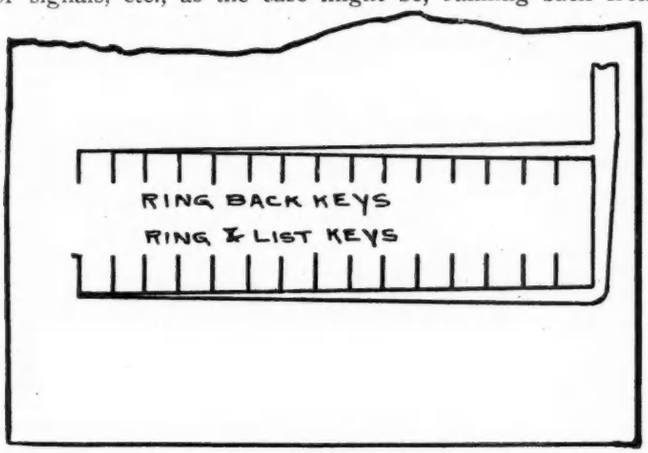


FIG. 2.

there to the cord racks. (From this point it is, in many instances, found quite convenient to provide an arm to run to the roof or frieze board for wiring such apparatus as may be located there.) Thence we run our cable arm back to catch supervisory relays, punchings, condensers, or any other apparatus that is located on the relay frame and connecting rack.

In figuring dimensions from one piece of apparatus to another one should always bear in mind the thickness or diameter of the cable, which should be deducted from the

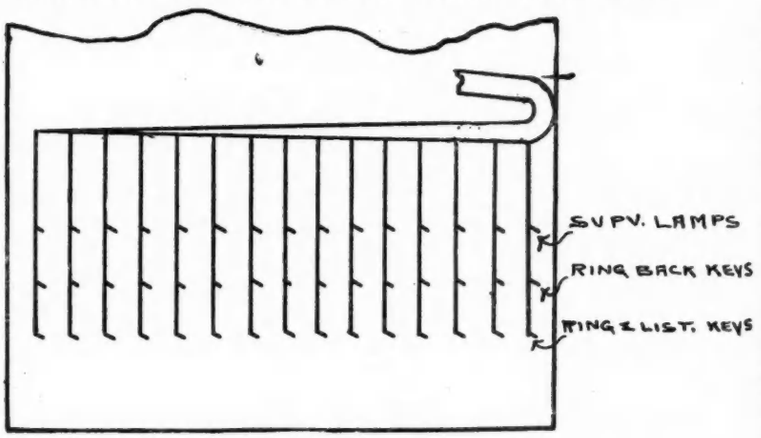


FIG. 3.

actual dimensions, otherwise we would get too much slack in our cable, which is quite difficult to do away with in the local sections. The best way in ascertaining the diameter of a cable is by actual measurement, starting with, say, about five singles or five pairs of wires and measuring them, then increasing by fives until we reach about 500 singles or pairs, which is about the limited number of wires used in a hand-made cable. When all measurements are taken a table of them should be made for future reference.

Never wire in such a manner, so that when the cable is soldered into the board, it will be impossible to remove the apparatus to which it is soldered, or any other apparatus. Skinners should always be left long enough to enable one to take out the apparatus without disturbing any of the others. In no case should a skinner be left shorter than two inches and only so when longer ones would spoil the appearance of the board, for should a wire become loose or disconnected, there must be enough slack in the spinners to enable one to re-solder it without splicing. Never do any splicing except when it is absolutely necessary, and then only when it does not appear in the talking circuit. It is, however, the best plan to make up a cable anew when found that it will have to be spliced out in order to make it fit. Fig. 4 gives us a fair idea of a good way in which to lay out a cable. Where a cable receives any rubbing, as it does in the opening of a key shelf, or if it comes in contact with any iron work, that portion of the cable should be well taped with Manson tape.

A cable laid out to provide power to the line relays, which are usually mounted on a separate rack, is very ef-

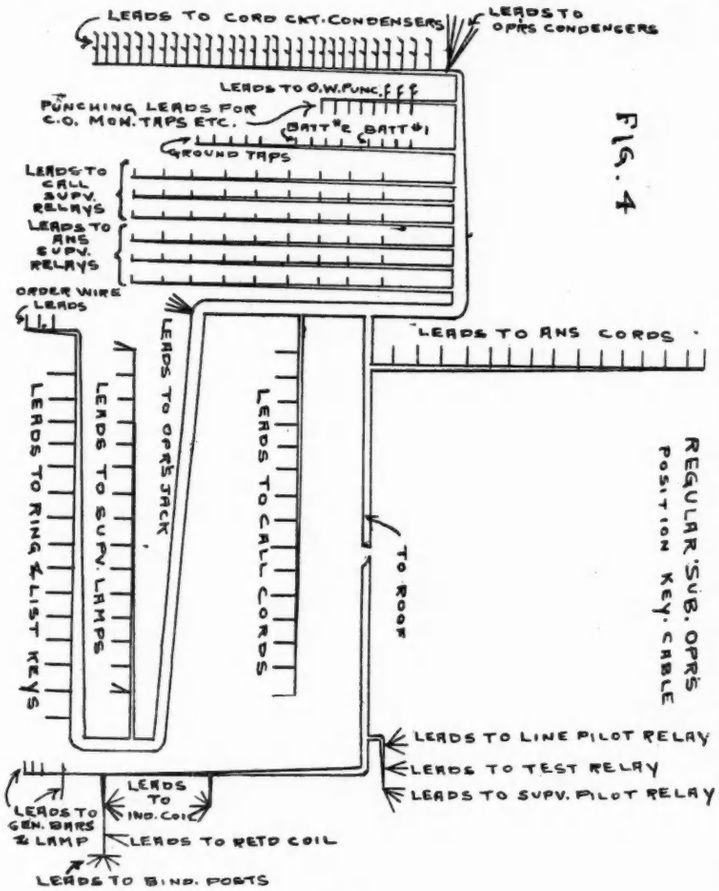

LEADS TO CORD CKT. CONDENSERS
LEADS TO OPRS CONDENSERS
LEADS TO O.W. FUNC. f f f
PUNCHING LEADS FOR C.O. MON. TAPS ETC.
BATT#2 BATT#1
GROUND TAPS
LEADS TO CALL SUPV. RELAYS
LEADS TO ANS. SUPV. RELAYS
ORDER WIRE LEADS
LEADS TO ANS CORDS
LEADS TO RING & LIST KEYS
LEADS TO SUPV. LAMPS
LEADS TO OPRS JACK
LEADS TO CALL CORDS
TO ROOF
REGULAR SUB. OPRS POSITION KEY. CABLE
LEADS TO LINE PILOT RELAY
LEADS TO TEST RELAY
LEADS TO SUPV. PILOT RELAY
LEADS TO GEN. BARS & LAMP
LEADS TO IND. COIL
LEADS TO RETD COIL
LEADS TO BIND. POSTS

Fig. 4.

FIG. 4.

ficient when made of okonite or rubber covered wire, the gauge of the wire varying with the load it is to carry.

Ordinary lamp cord should be avoided, if possible, as it makes a very bulky cable, there being a very good substitute of rubber covered and braided wire with a single conductor in the market which can be used where such wire is specified or desired. Under ordinary circumstances, No. 18 double silk and single cotton covered wire will be sufficiently large to carry the load required inside of the local sections. Generator leads are safest when run in twisted okonite or rubber covered wire and sewed into the cable last so as to prevent any inductive disturbances to lines which may be in use in that position. All other wiring may be run in double or single silk and single cotton covered wire, the guage commonly used being No. 22 or No. 24 B. & S.

The writer would be very grateful to any one who can furnish him with any further information or detail along this line, and will gladly endeavor to reply to any inquries which any one will send through TELEPHONY.

Article No. 2 will embody the laying out, figuring, etc., of machine-made cables.

OTTUMWA, IOWA, SYSTEM REORGANIZED.

Messrs. S. W. Crosby of Ashtabula, Ohio, and H. W. Stecher of Cleveland recently spent several days in Ottumwa, Iowa, closing up the business of the Ottumwa Telephone Company, and making the transfer of the title to all the property previously held by that company, to the Ottumwa Telephone and Electric Company. The business has been reorganized and will be known as the Ottumwa Telephone and Electric Company, of which Mr. Crosby is president and Mr. Stecher secretary.

Howard Herr will be retained as manager, and will have full charge of the company's interests in Ottumwa. Under Mr. Herr's direction, the business of the company has continuously grown from a small beginning until it now has nearly 1,400 telephones in the city and 700 in the country immediately surrounding Ottumwa. These, with the connections that can be reached through the exchanges in the smaller towns, Mr. Herr states, gives the subscriber access to about 15,000 telephones in Wapello and adjoining counties. In addition to these arrangements, the line has been entirely rebuilt under Mr. Herr's management. He is an incessant worker and has been the largest factor in bringing the business to its present standing.

In speaking of the new organization, one of the officers said: "The business is now in splendid shape, the details of the transfer have all been finished, and we are now going to still further increase the facilities of the plant and give the best service possible. We are very much pleased with Mr. Herr's management and assure the people of Ottumwa and vicinity that we are going to give them telephone service that will compare favorably with any in the country."

SOUTH BEND COMPANY IS GROWING.

The executive board of the South Bend (Ind.) Home Telephone Company recently held a meeting at Fort Wayne, to hear reports for the year, and the showing indicated that the South Bend company is doing a big business and is prosperous. Though its telephone system was installed but two years ago, the company already has 3,200 telephones in service in the cities of South Bend and Mishawaka. Practically all the stock of the company is owned in Fort Wayne.

The Home company recently completed the installation of 56,720 feet of aerial cable to relieve congested lines caused by the building up of several new additions in the outlying districts this season and the heavy demand for telephone service in various parts of the city. The company also installed 20,000 feet of underground cable to give service in several downtown districts where there were more subscribers than cable capacity, and also to connect the aerial cable with the exchange.

The company has experienced a wonderful growth during the past year and will issue a new directory on January 1 that will list 3,500 subscribers in St. Joseph county. Elaborate preparations were made for the annual reception on Saturday, December 31. The exchange was opened for public inspection from 9 in the morning until 9 at night to allow the people of South Bend and St. Joseph county to make a thorough examination of a modern and strictly up-to-date telephone plant.

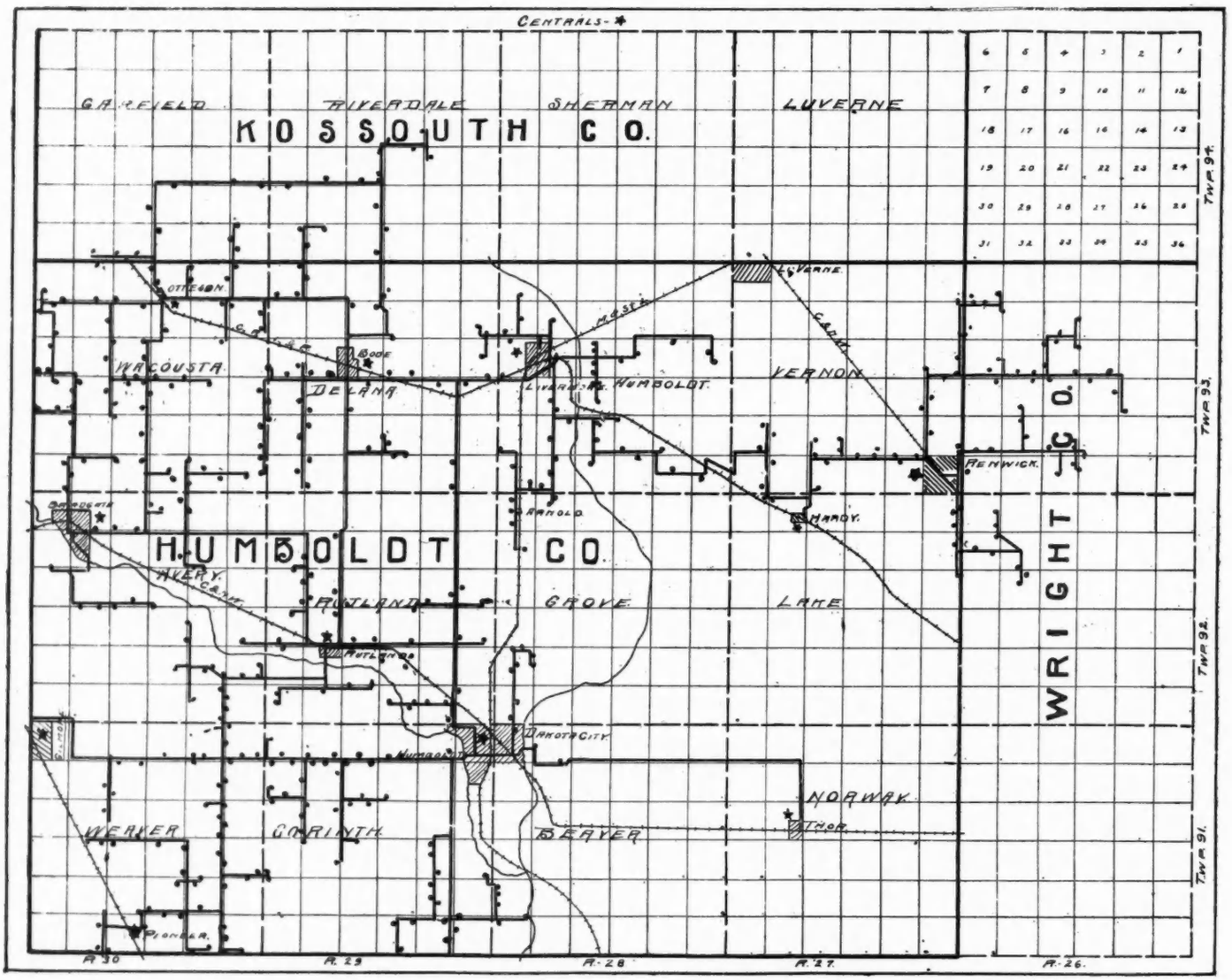
A Model Rural System

THE province of the telephone in the country districts is quite as important and full of possibilities as in the towns and cities of the United States, and one of the most promising features of the Independent movement in the past few years has been the almost marvelous development of the telephone in the rural communities, this being particularly true in the west and middle west. In Iowa the rural telephone has come to the front by leaps and bounds, and in many counties of the state, where a few years ago it was the exception for a farmer to have a telephone in his home, now the agriculturalists have become generous and confirmed users of this greatest of modern conveniences and scores of counties are covered with a network of telephone wires—the fruit of Independent enterprise—these counties in nearly all instances being interconnected and having most excellent systems of toll lines.

A notable instance of this growth of the telephone in the farming districts of the Hawkeye state is The Rural Union Telephone Company, a highly successful Independent organization, with headquarters and general offices at Humboldt, Humboldt county, and operating toll stations and exchanges in the following towns and villages—Bode, Bradgate, Hardy, Humboldt, Livermore, Ottosen, Renwick, Rutland, Thor and Pioneer.

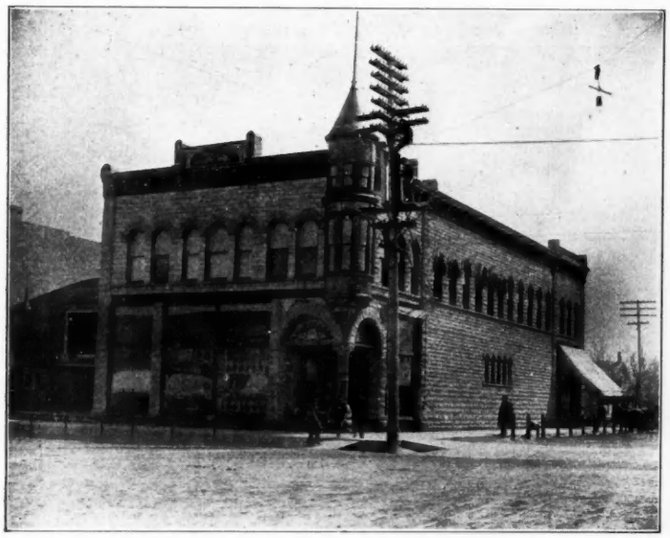
The officers of the company at the present time are as follows, having recently been elected, at a meeting of the directors, for 1905: President, H. S. Buell, Livermore; vice-president, E. K. Winne, Humboldt; treasurer, L. J. Clave, Ottosen; secretary, E. K. Winne, Humboldt; manager, D. L. Woodward. Directors: H. S. Buell, Livermore; E. K. Winne, Humboldt; L. J. Clave, Ottosen; T. O. Hanson, Bode; R. R. Smith, Renwick; S. F. Boyden, Bradgate.

The Rural Union Telephone Company was organized and incorporated under the laws of the state of Iowa in

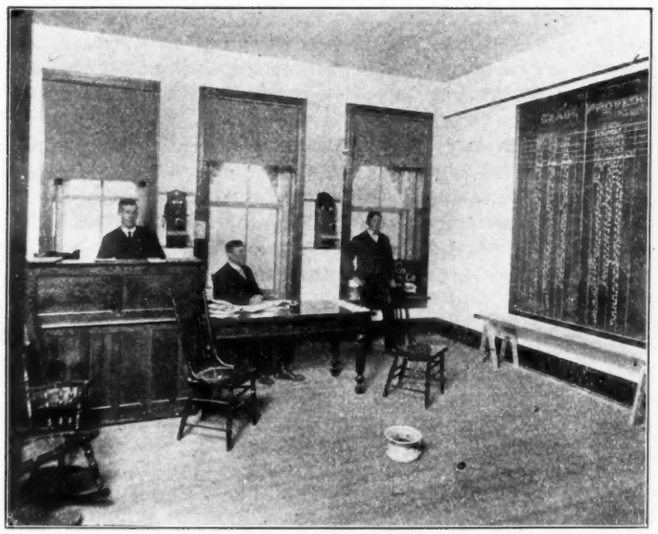


MAP SHOWING SYSTEM OF THE RURAL UNION TELEPHONE COMPANY.

August, 1902, with an authorized capitalization of $50,000. The first move of the company was to purchase the lines of the Farmers' and Merchants' Telephone Company of Ottosen, and those of Humboldt County (Bell) Telephone Company of Bradgate, replacing all apparatus with that of Swedish-American make, which so greatly improved the service that the company can hardly take care of the increase in business. In the years 1902 and 1903 it completed the construction of ninety-two miles of metallic toll line, using twenty-five-foot poles (twenty-six to the mile), and six-pin cross-arms; 262 miles of grounded farm line, using twenty and twenty-five foot poles (twenty-five to the mile). This gave it exchange and toll stations at Ottosen, Bode, Livermore, Hardy, Renwick, Bradgate, Rutland, Humboldt, Thor and Pioneer, all within Humboldt county. It then installed 500 rural telephones and 475 city telephones, a total of 975 telephones in operation, giving excellent toll service all through northern Iowa. All business telephones have full metallic circuits, and residence telephones, McClure circuits.



MAIN BUILDING, RURAL UNION TELEPHONE COMPANY.



MAIN OFFICE, RURAL UNION TELEPHONE COMPANY.

The Rural Union Telephone Company has connections with the Northern Telephone Company copper circuit at Humboldt; the Central Telephone Company of Iowa, at Thor; the Rolfe Telephone Company, at Bradgate; the West Bend Telephone Company, at Ottosen; the Corwith Rural Telephone Company, at Luverne and Renwick, and the E. H. Martin lines at Renwick. The company is thus giving its patrons the benefit of the very best toll service over copper metallic circuit to Des Moines, Davenport, and all the principal cities in the state.

CENTRAL EXCHANGE, RURAL UNION TELEPHONE COMPANY.

The main offices and exchange at Humboldt are built substantially and up-to-date, the building having all conveniences and being typical of the strength and enterprise of the company. The main cable lead is on fifty-foot poles, and the side leads forty, thirty-five and thirty-foot poles. There are 1,500 feet of cable on the main lead.

All the apparatus used by The Rural Union Telephone Company is of Swedish-American make. That it has given complete satisfaction is evidenced by the following letter from the Rural Union company to the Swedish-American Telephone Manufacturing Company of Chicago:

LIVERMORE EXCHANGE, RURAL UNION TELEPHONE COMPANY.

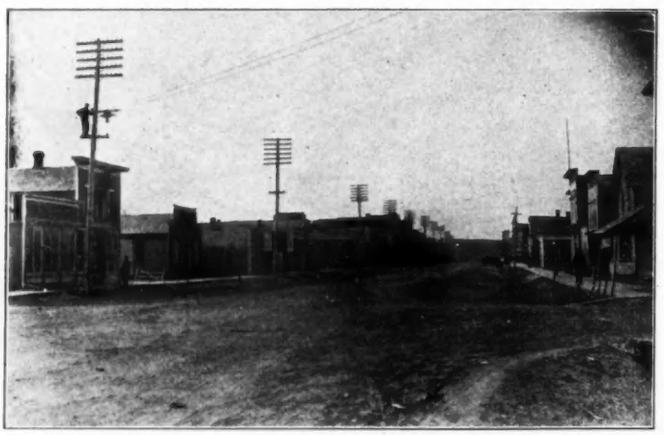
Gentlemen:—In answer to yours of recent date as to how we like the Swedish-American telephones and switchboards which you have been selling us for the last three years, would say that we have about 900 of your telephones and nine of your switchboards in operation, all giving excellent satisfaction; and the fact that we are still buying Swedish-American telephones, after trying several other well known makes, should read like an open book to you as regards

our opinion of your telephones, etc. They are O. K. and I can recommend them to anyone wishing a first class article that will "talk."

In proof that the company is well officered and that its future and financial affairs are in safe hands, it is only necessary to state that six of the men connected with the enterprise in an official capacity are bank presidents. H. S.

PIONEER EXCHANGE, PIONEER, IOWA.

Buell, president of the company, of Livermore, is head of the firm of Buell & Morse, dealers in lumber, grain, stock and coal, with yards and elevators at Hardy, Livermore, Ottosen and West Bend; E. K. Winne, vice-president and secretary, of Humboldt, is a member of the firm of Winne Brothers, real estate and loans, state senator from the fiftieth district of Iowa, and also vice-president of the People's Bank of Humboldt; L. J. Clave, treasurer and director, of



MAIN LEAD FIFTY-FOOT POLES.

Ottosen, is president of the Farmers' Savings Bank of Ottosen; T. O. Hanson, director, of Boda, is president of the State Bank of Boda; S. F. Boyden, director, of Bradgate, is cashier of the Bradgate State Savings Bank; R. R. Smith, director, of Renwick, is president of the State Bank of Renwick; W. N. Woolcott, director of Manchester, is one of the firm of Woolcott Brothers, wholesale lumber dealers, of Manchester; D. L. Woodward, the manager, resides at Humboldt, and has had six years of active work in the telephone business; H. W. McCauley, of Humboldt, expert bookkeeper and accountant, is auditor for the company, being recognized as one of the best in the state.

All of the above officials and directors are good, sound business men, have the confidence and good will of all who know them and each has made a success of the business in

MAIN STREET LEAD, BRADGATE, IOWA.

which he is engaged—a fact that accounts largely for the present prosperity of the company, and augurs well for its continued growth and success.

PROSPEROUS INDIANA COMPANY.

The annual meeting of the Home Telephone and Telegraph Company of Fort Wayne, Indiana, was of much interest to the stockholders, because of the excellent showing made by the annual reports, showing the end of the most successful fiscal year in the company's history. At the meeting 4,561 shares of stock out of 5,000 shares were represented. The stock is distributed among 127 persons, all but two of whom are residents of Fort Wayne.

The report of Secretary Moellering showed 3,220 telephones in operation, a gain of 400 over last year. New telephones are being installed now at the rate of fifty per month. Upon the Home lines are more than 1,000 business houses in Fort Wayne. The company now has nearly 200,000 feet of underground and aerial cable in service, and 25,000 feet has been added during the past year. It is the intention of the company to expend $15,000 in cable extensions and farm lines within the next six months.

The company's capital stock is $250,000, all issued; it owns $40,000 worth of real estate and has no debts except the bonded indebtedness of $250,000. The company is laying aside 6¼ per cent per annum of its earnings to create a sinking fund to ultimately redeem the bond issue in 1918. The sinking fund now amounts to $32,000, to which $16,000 will be added annually.

The company now has farmers' lines on the Lima, New Haven, Piqua, Winchester, Leo, Maysville and Hicksville roads and new lines will be strung at once on the St. Joe and Goshen roads, so that in a very short time the entire county will be supplied. There is now building an extension for 520 new lines on the switchboard and the toll connections are constantly growing. Mr. Moellering reported a through line, without relay connections, to Lima, Ohio, in process of erection.

The growth of the south side exchange is very gratifying, there being now 800 subscribers in that section. The Home company employs sixty girl operators and thirty-five men, and the pay roll aggregates $40,000 per annum.

Simultaneous Telegraphy and Telephony

JOSEPH HOLLOS.

THE question of simultaneous telegraphy and telephony is not of recent date. While, however, in some places, good results have been obtained, in others the advantages reached by this combined using of telephonic circuits are hardly worth mentioning, and in view of the difficulties experienced in the service, it was thought preferable to abandon the scheme.

If we look closer at the question, we can at once observe that wherever the telegraph and telephone services are under the supervision of one and the same interested person, the results obtained are excellent. Where, however, the two systems are in different hands the result is unsatisfactory. Thus, in America, where the financial interest of the telephone companies is involved, because of the desire to increase income by leasing lines for simultaneous telegraphy, and where, for this reason, these two operations are under the control of one technical staff, the result is excellent. The results are also fair in the European services, if the same technical officer supervises both telegraphy and telephony, and one service is co-ordinated with the other. The result is, on the contrary, very poor in all cases if the telegraph and the telephone services are in different hands.

This is evident if we consider how greatly the one system interferes with the other; that is, that careless handling of the one interferes at once with the proper functioning of the other, the two systems thus being brought into mutual opposition.

For this reason the service must be arranged in such a manner that the two system cannot interfere with each other, and inasfar as troubles are unavoidable, they must be reduced to a minimum. If they should exceed certain arrangements must be provided to hold out the less important service without delay.

In this direction the Hungarian telegraph and telephone service can show good results by comparison with similar installations, and, therefore, it will not be without interest to outline the principles which were followed in the formation of the system.

Above all, the simultaneous installation must be the simplest possible, because only thus and with the fewest possible instruments may undisturbed working be obtained. For this reason the method of simultaneous working, founded on the Wheatstone bridge principle, was made the basis of procedure.

The telephone circuit is closed through two inductive branches. At their point of intersection the battery branch is led off to the group of telegraph apparatus, while the telephone apparatus is placed in the so-called galvanometer branch.

It is thus evident that the connecting-in of the telephone apparatus—namely the leading of the telephone circuit through the switchboard—requires some care, because if there is a ground in the switchboard connections, the telegraph working is disturbed. Even if one telephone circuit is directly connected to another, and there be simultaneous working on the latter, the two telegraph simultaneous systems are brought into contact, which again causes marked disturbance. This may also be caused by the operators ringing simultaneously on several circuits from the same common source of ringing current.

Even if only one of the circuits fed from the common ringing source is connected for simultaneous telegraphy, such working will still be slow, because, in ringing on the simultaneous conductor, we ring also on five or six other conductors. However well insulated these circuits may be individually the insulation of the simultaneous telegraph circuit will be so far reduced by the connection that it will hardly be possible to maintain continuous telegraph working.

It is true that we can remove all these difficulties at one stroke, by connecting the incoming telephone circuit, before leading it to the switchboard, to a repeating coil and working then only on the other half of the repeating coil. But by this plan the difficulty is only transferred to the other side—the telephone side. Above all, we have a loss of energy in the repeating coil, to which are added losses inevitably occurring in the signaling apparatus, and it may happen that with such an arrangement the telephone subscriber does not get as much as 50 per cent of the incoming speaking energy into his receiver. We must strive, therefore, that along with the undisturbed working of the telegraph, the telephone working be kept at the same relative level that would exist in the absence of simultaneous working. Moreover, the repeating coil not only weakens the speaking current, but also the calling current, and we must, therefore, take precautions in this direction.

Under these conditions it is inadvisable to connect the circuit first to the repeating coil. As long as the circuit is on the calling apparatus there is no danger of disturbing the simultaneous working. The disturbance arises only at the moment of connecting. For this reason it would be sufficient to place the repeating coil in the connecting cord; but in the same path there is also the clearing-out signal, and a great loss of energy might thus be incurred. This we may, however, remedy if the repeating coil is constructed in such a manner as to serve at the same time as the clearing-out signal.

The clearing-out signal is, as a rule, connected in the bridge between the two branches of the circuit, and its duty is by its great self-induction to prevent the wasting of any considerable part of the speaking current. How far it is able to satisfy this demand might be readily ascertained by inserting a receiver in the shunt path. In spite of thus increasing the impedance of the bridge, we still obtain intelligible speaking even with a clearing-out signal of 2,000 ohms resistance, if the latter is entirely embedded in iron. These currents do not so rigidly follow the rules which apply to strong currents and, therefore, inferences drawn from such rules do not apply in this case, as may be shown by a simple experiment. With such a clearing-out indicator 30 per cent of the energy is lost on the average, and 70 per cent only is available, as I have been able to ascertain myself.

With a well-constructed repeating coil, if arranged as a clearing-out signal, the loss is not greater. Consequently if we insert such a repeating coil into the connecting cord simultaneous working without affecting the telephone is secured.

The repeating coil transformed into a clearing-out drop naturally possesses a closed iron circuit. In European practice this plan is avoided and an open-circuit repeating coil is generally preferred. The question whether the repeating coil has an open or closed magnetic circuit does not affect the high frequency involved, and for weak currents this is of much less importance than the other losses that arise in an open-circuit repeating coil.

For relatively strong signaling currents the closed iron circuit is of decided advantage, because with open-circuit repeating coils it is only exceptionally possible to ring through with alternating current, while it is always certain when there is a closed iron circuit.

Paper read at International Electrical Congress at St. Louis.

Northwestern Cedarmen's Annual Meeting

THE Northwestern Cedarmen's Association will hold its ninth annual convention in Milwaukee on January 3, and every indication points to the fact that the meeting this year will be even more largely attended and successful, if possible, than the one held last year in Chicago.

The text of the convention call issued by Secretary J. F. Hayden of Minneapolis to the members of the association is as follows:

"Pursuant to instructions from the board of directors, you are hereby notified that the ninth annual meeting of this association will be held at the Pfister Hotel, Milwaukee, Wisconsin, on Tuesday, January 3, 1905, at 2 p. m.

"All standing committees will meet at 10 o'clock in the forenoon of the same day, at the same place, to prepare such reports as it is desired to present at the meeting. The board of directors will meet at the same time. Any matters for the consideration of the committees or the directors should be in the hands of the secretary before that date.

"If there are any members of the association who cannot be represented at the meeting, it is desirable that they should, previous to that time, send to the secretary such information regarding the condition of stocks in their hands and their contemplated input this winter as will be of value to the association in determining values for the opening of the new year."

An interesting programme has been prepared, to conclude with a banquet in the evening at Hotel Pfister.

The present officers of the association are as follows:

President, H. W. Reade, Escanaba, Michigan; vice-president, Daniel McGillis, Milwaukee. Directors, E. H. Valentine, Chicago; O. Erickson, Escanaba; W. H. Coolidge, Minneapolis; F. W. Robinson, Gould City, Michigan.

H. W. READE, PRESIDENT CEDARMEN'S ASSOCIATION.

The cedar pole trade the past year has been most satisfactory, and the prospects for the coming year's business is said to be the most promising in the history of the association. The members are all optimistic as to the outlook, and are making preparations in accordance with the general belief that 1905 will be the banner year in the cedar pole trade. TELEPHONY has secured a number of interviews with prominent cedarmen on prospects for the coming year, which are herewith published:

Wright Brothers, Marinette, Wisconsin: It looks to us as though 1905 would be a banner year for the cedar pole trade, and we expect to make preparations for a big trade.

Page & Hill Company, Minneapolis: We are looking for a very prosperous year in the cedar pole line. So far as volume of the trade is concerned, the past year has been a very satisfactory one with us, but prices ruled low. They are now showing a stiffening tendency, and we look to see not only a good volume of trade, but better prices all around for 1905.

C. H. Worcester Company, Chicago: From present indications we look forward to an improvement in volume of cedar pole consumption during the season of 1905. The larger companies that usually contract for their requirements show an increase in their estimated requirements, and this is usually an index of the general situation. However, we do not see anything in the situation other than a good, healthy condition and do not look for any radical advance in values. The production this winter will be less than usual, but, on account of considerable stock being carried over, we feel that there will be enough stock to supply the demand comfortably.

We notice a marked tendency among the better class of pole consumers to discriminate more closely in regard to quality of poles. The trade is beginning to realize that there is a great difference in the strength and life of cedar poles, and to insure uniform life and strength they are insisting on butt measurements, which throw out "slim jim" poles and guarantee to them "stocky" poles, which will carry the increase in traffic, stand the stress of storm and furnish a larger diameter at grade line to offset the ravages of decay at that point.

During the past two years large quantities of these "slim jim" poles have been produced in the northwest and distributed throughout the west at very low prices. For temporary purposes they answer very well, but we find that companies that are planning for the future life of their lines are discriminating against this kind of stock.

Marshall H. Coolidge Company, Minneapolis: There will be an increased production this winter—not large—but stocks bid fair to be well rounded out. There will be a curtailment in fence posts, and an increased production in dimension stocks. Inquiries for the trade are entirely satisfactory, and we are looking forward to a good demand at fair prices. We would be very much disappointed if prices reached any lower level than the present.

Wisconsin Land and Lumber Company, Hermansville, Michigan: Ties and poles have brought good returns dur-

ing the past year, and for the coming year we believe that all kinds of poles, both short and long, will be in good demand.

It will be seen that the general tone of the above expressions is of a most hopeful nature and that it augurs well for the cedar trade the coming twelvemonth. As far as TELEPHONY can learn—and it has made extensive inquiries—the sentiments enunciated by the firms above quoted reflect the feeling that pervades the entire cedar trade.

USES OF THE TELEPHONE.

"I never appreciated what the telephone may mean to a 'shut-in,'" said the wife of a New York literary man, writes Bernard P. Brown, in the New Era Illustrated Magazine, "until the winter before last, which we spent in New Hampshire. It happened that my husband was out of health and that he had on his hands an important book which his publisher was pressing him for, which could better be finished in the absolute quiet of the country than anywhere else. We own one of those delightful abandoned farms that are so common in New England. We had furnished the house sufficiently for comfortable living, and there seemed to be no reason why, with the children away at boarding school, we should not save rent and worry by spending a winter among the hills. We both like the simple life, are enthusiastic amateur naturalists, and did not feel that there would be any hardship in cutting loose for a year from city life. Our experience, on the whole, was a very pleasant one. Still, I don't believe we ever could have stood the isolation but for the telephone which we had put into the house the autumn we determined to stay there. You can scarcely imagine the convenience it was as a matter of practical housekeeping. With butcher and grocer four miles away, the opportunity to get word to them at a moment's notice was of inestimable value. In December there came a huge snowstorm, which piled the roads so deep that it was nearly a week before the oxen came through with the rollers. I must confess that during that time both my husband and I felt the need of genial human companionship and that we frequently enough rang up our friends at the village. On Christmas Eve we even committed the extravagance of calling up several of our friends in New York. You may fancy how good the sound of their voices was as we heard them two hundred miles away."

Everywhere in these days one hears the same story. The American woman, whether in city or country, is becoming as dependent upon the telephone as her husband in his store or office. She orders the family dinner by telephone, upbraids her dressmaker by telephone and electioneers by telephone for the presidency of her club. If she happens to live in one of the houses equipped with the latest pattern of telephone apparatus, she gives orders to the cook in the kitchen without leaving her chair in the sitting room, for the telephone has taken the place of the speaking tube in the up-to-date city residence. No habit grows by what it feeds on more rapidly than the telephone habit. If the telephone is a boon to dwellers in city houses and apartments, even more so is it a blessing, as the New York woman just quoted discovered, to dwellers in distant hamlets and on the farms. The monotony of the life of the average American woman whose life is spent on a farm has long been a fruitful theme for writers of fiction. The dreariness of existence, quite as much as hard work, is what makes the housewife in the rural districts grow old before her time. The monotony has, however, in the last few years been greatly lessened in most communities. Thanks to new methods of agriculture, the abundance of newspapers and magazines, correspondence schools of many kinds and, above all, to the new means of communication afforded by the telephone, the farmer and his wife need be no longer isolated. They have come within the industrial and social circle.

The telephone, besides being of business assistance to the farmer during his busy season, when crops have to be harvested and marketed, is a great social convenience to his family all the rest of the year. Neighborhood news is flashed back and forth over the farm telephone lines. Even the blizzards, if the wires are unbroken, put no stop upon friendly communication. The farm woman finds the telephone a protection as well as a convenience. If the house takes fire, help can be summoned immediately. The predatory tramp ceases to be a terror, for he looks askance at the telephone wire entering the house, aware that upon any lawlessness the whole countryside will be aroused and set in pursuit. And particularly, of course, in cases of illness the telephone proves valuable. One of the hardships of life on the farm has always been the difficulty of securing prompt medical assistance. In many a country neighborhood you now hear stories of lives saved because the doctor was summoned by telephone hours earlier than he could have been secured in the old days, when the farmer had to harness his horse and set out on the long drive to the village. Often in cases of slight illness a little conversation over the wire is all that is necessary to suggest the remedy; the long drive and professional visit are dispensed with.

Women in country neighborhoods often show themselves singularly alive to opportunities afforded by the telephone. In one case a lineman who was sent to inspect a tural line in a western state where a large number of subscribers were carried on a single line found the woman of the house contentedly knitting while she sat in her rocking chair with the telephone receiver tied to her head, so that she might be sure not to miss any talk that went on between her neighbors. Another story is that of a woman who had to go on an errand some distance down the village street. She did not want to take her baby along with her, and at the same time she wished to feel certain that the child was not crying at home. Accordingly, she took the receiver from its hook and left it on a table near the cradle, so that if baby began to cry the central operator would hear the child and call up the mother at the grocer's.

A recent instance of ingenuity in telephone using is that of the boys who did not allow a case of smallpox in the family to stop their school work. Their home was quarantined, but, at the suggestion of the school teacher, made over the telephone, the boys studied their lessons every day and recited by telephone in the evening. The incident serves to suggest in what great measure the telephone has served to mitigate the anxiety and trouble of persons shut up in houses where there is contagious illness. It is no longer necessary for friends and relatives to communicate with those in the home by calling their message from the street, and the telephone is a friend always at hand to keep the quarantined family in touch with the outer world.

Nothing gives a better idea of the extent to which the telephone has become a business and household utility of highest importance than some of the discoveries which have been made. Telephone men have found, for example, that in the early morning all the grocers in the large cities are using the telephone so frequently that the switchboards must be arranged with special reference to taking care of this kind of business. A little later in the day at the financial centers the wires are kept hot with messages from the offices of bankers and brokers. Telephone experts will also tell you at what time of day people talk with their lawyers, when they buy their theater tickets and when they arrange for evening social diversions. Just what is said to the grocer, the banker, the lawyer, the ticket agent, does not go on record, because the apparatus at "Central" is arranged so that nobody hears the words spoken by one subscriber to another.

The Automatic Problem

F. V. L. TURNER

THE meetings of the International Congress of Electrical Engineers, held in St. Louis from the 12th to the 17th of September, had very little significance so far as the general public is concerned. The fact that the meetings were held was known to the profession almost exclusively. Newspapers mentioned the fact in a casual manner; yet, it is a fact that these meetings brought together the entire electrical profession of the world, and the wide scope of the discussions carried on, the relation these discussions bore to the mercantile, maritime, governmental and financial interests of the countries represented, is beyond the conception of the layman. The profession of electrical engineering is divided into several branches, each branch, in the Electrical Congress, being composed of several smaller branches, and formed into one section. It is the purpose of the writer to touch upon that part of Section "G" which dealt with telephony.

F. V. L. TURNER.

As the result of extended use, its efficient time-saving capacity and its convenience, the telephone has become quite well known. Through the legal battles waged by individuals, corporations and municipalities and by the publicity of the press, the telephone using public has been led to consider the Bell Telephone Company as a monopoly and as a consequence has built a great many Independent telephone plants, forcing, by competition, the Bell company to lower its rates. Numerous systems have been invented and patented by as many different manufacturers and employed for this purpose; some of such systems having been long ago discarded as impractical, some still live, while others are in extended use, giving just as good service as the systems of the pioneers.

In later years the automatic sprang into existence and has made some headway in the field of the Independent users. How much or how little will be fully shown by the number of exchanges in use, and full consideration must be given to the fact that until recent years only experimental apparatus was manufactured; that to-day we have in operation more manual exchanges of greater capacity in single boards than the automatic and Bell combined.

This International Congress discussed freely the "Automatic vs. the Manual Board," the discussion being carried on by some of the brightest men in the Bell and Independent fields. Mr. Kempster B. Miller, in his paper read before the congress, on "The Automatic vs. The Manual Telephone Exchange," makes clear *his* failure to solve the problem and expects the purchasing public to likewise fail; the purchasing public must and will have sufficient knowledge upon the subject to rightly guide them in the expenditure of the enormous sums placed yearly in the telephone business; likewise, those who invest their millions in the manufacturing end. Mr. Miller states that the automatic "cannot be assumed at the present time to have reached a relatively high development," but does not tell us why. Must we declare to ourselves why, or must we continue to assume? Or rather, let us give credit for the persistence and for keeping "everlastingly at it" in placing it before those who bought and learn therefrom a lesson.

Quoting Mr. Miller, "The unequal degree of development of the two systems" will strongly appeal to the purchaser, when knowing the risk taken in purchasing apparatus out of which he must pay interest and dividends. If there is any reason for the existence of an automatic exchange, other than the fact that the operating company is led to believe in purchasing that the cost of operation is eliminated in part without a single ray of light as to cost of maintenance, it cannot be substantiated that the subscriber will perform without cost this operation in addition to his annual rental. The province of the automatic is well known, and while our departed though delighted entertainer may have been right as to the price of admission to his circus, the public will not always "like to be fooled," especially in the vital matter of telephone service. Practical jokes on your rival in business in the shape of a connection by automatic and forgetting to replace your receiver, thus tying up his line, are not quite as aggravated as an attempted call in a dark room for fire, police or the physician's protection and assistance. If human intelligence is necessary in conjunction with a machine in a supplemental way add enough to produce just such satisfaction as is given in most of our cities by manual boards.

Taking the paper of Mr. Miller as a whole it will appear that its tendency weakens the automatic in its present state and shows where the proper automatic must begin its development, at a semi-automatic point. With the high first cost of an automatic against the present cost of manual (and its possible reduction, as shown later) we must halt in our blind following of a phantom—no operators' salaries and no expense incidental to such operators.

The only effective automatic was first known of in 1879, since which time the game of shuttlecock and battledore has been played with it. It has been considered and ignored by great interests, because it appeared to be a money loser. The larger interests have adhered to the manually operated board in an effort to combat competition and furnish the highest class of service.

Ordinarily, it must appear that if the automatic has solved the problem for all classes of cities, the Bell companies would adopt it, even though thirty years had been expended in perfecting the present manual board. Independent manufacturers have profited by these thirty years of thought and labor, and are, and have been, placing on the market systems far superior and at less cost. In later years it has again become prominent through the constant

injection of new money and the doubtful business principle of placing it on exhibition in a few exchanges with an agreement to paid for if it is not thrown out in a given time, such payment to be made at the pleasure of the purchaser. In adopting the automatic the investors in a given exchange, and those managing it, are certainly, if nothing else, honest in their intentions, but afraid to admit publicly, by replacing the apparatus when almost too late, that they were mistaken.

Cost of maintenance of a manual board and its complement of instruments is a well-known and absolute quantity. Maintenance of an automatic board and instruments is conjectural and problematical. It can be stated with decisive certainty that there is no data at hand as to the cost of maintenance of the automatic board or instruments. The retrograde movement in the automatic toward the local battery is a vital subject for consideration. Should it occur that the absence of competitive manufacturing in the automatic field delay the proper improvement, battery renewals and operators' salaries may be an equal offset to each other.

With the foregoing before us it becomes necessary to arrive at the proper apparatus for the purpose required. It must be acknowledged that no two cities of equal magnitude in population and area can be treated alike, even assuming that the class of telephone users in each case are the same. Geography must, to a certain extent, enter largely into the engineer's calculation for cable distribution, and in consequence, he will decide the establishment of one or more exchanges, as the zones of economy will appear. There cannot be any simpler or more economical method of covering certain sized cities than with one exchange of a full multiple type, central energy, with the simplest form of instrument, requiring only the lifting of the receiver from its hook to signal the operator The American requires the greatest rapidity of service and as little wasted time as possible; hence, automatics requiring the subscriber's assistance will not permanently appeal to the user to any greater extent than would the automatic trolley car, wherein each passenger would be his own motorman and conductor. It is said we are living in an age of automatics. We are, in certain directions, but will any of us believe we could consent to an automatic restaurant in which the turning of a dial would stamp out a steak, a roast, or our chops, with the manipulation of a lever pouring us a cup of coffee while our feet secured with a pedal buttered toast? Not yet. The earth is not now so crowded that we cannot find room for a kitchen, with its "home cooked."

Where the zone of economy requires more than one exchange, the percentage of trunked calls to the total local calls will of necessity govern the load (in number of subscribers) each exchange shall carry; if the practice of establishing a so-called "main" exchange is adhered to the board used will depend upon the percentage of trunked calls to the total local calls handled at such "main"; the advisability of a multiple board or the advisability of a transfer board, eliminating entirely the multiple, and making the transfer an automatic manually operated will appear. In the case of sub-exchanges the same conditions will obtain.

In the largest cities the design of an exchange system will be along the lines known for economy as to cable distribution and which such switchboard apparatus as will be so constructed as to have all subscribers' lines for incoming calls enter an operating table handled manually and the called for subscriber automatically selected in the home or distant exchange, though, preferably, the cord circuit, with clear cord pairs for toll or long-distance purposes. The outgoing side of the system will be automatically controlled and operated manually. Subscribers' substations will be free from any other mechanism more than is at present used in central energy work. Such a system for low cost of maintenance, simplicity of apparatus, low cost and flexibility of operation, is the nearest approach to the ideal in an exchange district as described.

Operating men know full well (and Mr. Dommerque in his paper makes especial efforts to emphasize the call-wire evil) the combination of trunk and call wires and the consequences of their use. It is also well known that the elimination of one operator in completing a trunk connection would reduce the errors fifty per cent and save 100 per cent of the lost time consequent upon such errors. Place against this time the time required to manipulate an automatic selector of the type in use by Independent, or Bell companies, and we have gained fifty per cent of operators' wages and eliminated fifty per cent of errors, and all the lost time consequent thereupon, and it can safely be stated that with only one operator the errors will decrease more than fifty per cent, as there will be an absence of the operator who formerly received the blame for the others' mistakes. The responsibility successfully placed will give better results.

Change the automatic selector in present use, or rather substitute standard button or key construction therefor in the shape of ten buttons or keys numbered from 0 to 9, and we have given the selecting operator the means of as quickly manipulating a trunk call (having eliminated the order wire feature) as the keys on a typewriter are operated. This scheme of ten numbers would only answer for a three-numbered exchange. For any number above three a duplicating button or key for an additional selector would be used. Thus a four-numbered exchange would have ten straight buttons or keys and one duplicating button or key, five-numbered, ten straight buttons or keys, and two duplicating buttons or keys, etc. The switches and selectors would be identical and composed of quick acting sensitive relays with the proper wiring, and not the step-by-step, time-killing thresher-like mechanism now in use, with its multiplicity of parts, all of which are susceptible of trouble.

At this point it might be well to state that in a four-numbered automatic exchange, one calling switch, two selectors and the called for switch are brought into use, involving the employment of 315 parts each, a total of 1,260, plus the hundred and odd parts of the two instruments! Quite sufficient food for thought as to maintenance against the twenty or less parts of an ordinary two-wire common battery or magneto system.

In speaking of the full central energy, full multiple exchange for certain geographical conditions, reference is made more particularly to Cleveland, Ohio, as an example. With its length of twenty-five miles between the two most distant sub-exchanges along the lake front and a territory requiring very few trunking facilities at right angles to this direction, an extensive growth in circumferential area will necessarily have to take place before such a board will be called upon to handle any such trunking condition as New York, Chicago, or Philadelphia, for the reason that only fifteen per cent at the utmost of total traffic handled is trunked.

If eighty per cent of the traffic of any exchange is trunked the expenditure for the multiple was useless. The possible low cost of a non-multiple automatic transfer and ringing board is more than inviting to the purchaser and still more satisfying to the stockholder. With a difference in first cost of forty per cent in automatic over manual lies the greatest discrepancy found, and this forty per cent can be increased with the board above described.

For single exchange cities and towns, the outcome eventually will be multiple central energy or magneto boards with the exception of 200 lines or less, also in such other and larger exchanges handling farm lines; the bare fact of size makes the manual imperative; the operator is necessary to handle farm line propositions, the automatic making no provision for handling such business. The failure of the automatic to provide party line service, both for telephonic educational purposes and to meet competition, aside from the all important money producing aspect, is more than the busi-

ness end of a telephone organization can grasp, and is largely in evidence to show the inflexibility attending its use and its possible electro-mechanical complication. These complications seem to have reached their limit.

So far the history of the automatic shows that the Bell companies have profited by its installation. Among other notable cases, Augusta, Georgia, (with its several automatic installations) and Birmingham, Alabama, are excessive examples. Midland, Texas, replaced the apparatus.

Diligent inquiry as to cost of maintenance on automatic boards and instruments first installed can result only in statements that the apparatus placed in operation then was in its infancy and therefore crude. It was, and in comparison with modern manual apparatus, the present automatic is crude, both electrically and mechanically.

Mr. Edward E. Clement, in his very able paper before the Independent telephone convention at St. Louis, remarked that there are two things most everyone has tried his hand at—step-by-step telephone switches and car couplers, both of which have been "absolutely overworked." The history of a country is its literature; the history of the telephone is its apparatus. After careful perusal of Mr. Clement's paper, the investor will hesitate before applying his money to the development of schemes which are "absolutely overworked," "car couplings and step-by-step telephone switches or selectors."

Of 715 patents issued for switchboards, 465 cover multiple boards and circuits exclusively, a large proportion of this number being circuits or systems, the rest single or transfer boards, but none of these patents referred to cover automatic apparatus. Of 577 party line systems patented over 200 employ step-by-step selective mechanism, and is it necessary to state that none of them is in commercial use?

Let me quote Mr. Clement verbatim: "Last, but by no means least, there are 125 patents for automatic exchange systems and apparatus. The actual number of automatic patents is small, but I assure you they must be measured by weight to be appreciated. *No living man knows all the details of all the apparatus in those 125 patents, and no man ever will, not even the inventors themselves!* Some of the devices are wonderfully and fearfully made, and some are distinctly abortions."

Most of the investors in telephone securities look for a reasonable degree of certainty of continuous operation of the thing in which such investment is made, and with every feature of the automatic problematical, how can such a condition exist? It appears without much mental effort that an established manual system, furnishing the highest class of service known, with a known earning power, the result of years of thought, designed by the ablest men in the manufacture of apparatus, with a full knowledge of the requirements of the user, will be looked upon more favorably than something which has not yet been able to demonstrate its low first cost and cheapness of operation and maintenance, and which has so many other objectional features.

BURNED OUT EXCHANGE ARISES QUICKLY.

The Petroleum Telephone Company, operating in Oil City, Franklin, Titusville and Pleasantville, all in the state of Pennsylvania, recently met with a serious loss through the destruction of its Oil City exchange by fire. The Oil City *Derrick* refers to the fire as follows:

One of the first acts of the firemen was to inquire as to the safety of the tenants. Misses Curtis and Sittig, the night operators at the Petroleum office, notified Manager Paca that there was considerable smoke coming up from below and asked him for instructions. He telephoned them to take no chances, and at once started for the office on a street car. The young women, with rare notion of duty, stayed at their tables until the smoke began to blind them, and when they then started down the stairs they found their egress blocked. They then went to a window on the Elm street side of the building and called for help. Ladders were hoisted and the young women were carried down to the street, showing the same courage and self-possession they had exhibited throughout their trying ordeal.

While the fire was at its height Manager Paca of the Petroleum Telephone Company sent a telegram to Erie and ordered a new switchboard, and hopes that there will not be much inconvenience caused patrons. Offices have been secured in the Lamberton block, and wires will be installed at once, the work to be prosecuted night and day until completed.

The fire originated in the basement of the large brick building owned by Smart & Silberberg, who occupied the greater part of the building as a department store, the other parts of the building being occupied by offices and the Petroleum Telephone Company. It is of interest to note that the fire did not originate in the part of the building occupied by the telephone company.

The temporary switchboards were obtained from the North Electric Company of Cleveland, the Union Telephone Company of Erie, and some parts were built in the shop of the Petroleum Telephone Company, and all subscribers were connected with the temporary switchboard in the new offices of the company within ten days after the fire.

The Bell company put in extra solicitors from Pittsburg and attempted to get the Petroleum Telephone Company's business, but were unsuccessful, as the company did not lose a single subscriber, but actually made a gain of thirty subscribers during the month of November. The Petroleum Telephone Company has nearly double the number of subscribers that the Bell company has in the same territory, the Petroleum Telephone Company having 950 subscribers in Oil City, 725 in Franklin, 600 in Titusville and 45 in Pleasantville, the Bell having no exchange at all in Pleasantville.

The company's system includes long-distance lines throughout Venango county and connections with the lines of the Union Telephone Company of Erie, Pittsburg & Allegheny Telephone Company at Pittsburg, Forest Telephone Company, Emlenton Telephone Company and Kennerdell Telephone Company, which gives it connection with over 200,000 telephones in the states of Pennsylvania, New York, Ohio, Michigan and Indiana.

A contract has been made with the Stromberg-Carlson Telephone Manufacturing Company for a full central energy lamp signal board for the Oil City exchange. The company reports an abundance of new business and is in a very prosperous condition.

NEW USE FOR TELEPHONE.

Here is a new and amusing use for that omnipresent modern convenience, the telephone, a use reported from a busy Massachusetts telephone center. In this particular district many of the inhabitants have apparently just realized that having a telephone is equivalent to living next door to the police station and sometimes a protection, therefore, against such nuisances as noisy neighbors, who would pay no attention whatever to the remonstrances of anybody less awe-inspiring than the policeman. The man or woman who is kept awake late at night, for example, by piano playing in some adjacent and more lively mansion, no longer tries to escape by putting his head under the pillow. Instead he gathers his "nightie" about him and proceeds to the telephone, by which medium he relates his tale of woe to the ears of the nearest police captain. The police captain notifies the officer on the beat, again by telephone, and if the noise is anything that can be legally classified as an imposition upon a neighbor's feelings, the officer puts an end to it.

Views on Measured Telephone Service

HAROLD D. STROUD.

THE Problems involved in dealing with the matter of selling telephone service must be as economic measures and from a purely business standpoint, rather than from technical or electrical standards, although it is true that it is through the instrumentality of the latter that success is to be attained.

Some of the greatest mistakes in telephone work have been because of failure of the companies to give more heed to questions of business and policy, relating more especially to the non-technical side of the business.

Leaving all questions relating to competition out of the consideration, we have a business founded purely for the exchange of commodities. The wares which we have to sell we call telephone service, of which there are commonly two general classes: First, that which relates to the transmission of vocal intelligence between towns or points of great distance. Second, that by which persons within the limits of a city or community may be telephonically brought into conversational relation. The first we call long-distance service; the second we have chosen to term local service.

The money invested in the telephone exchange, the lines and telephones are in effect analagous to the funds which are invested by a merchant for a place in which to conduct his business, and the service which the telephone man gives by the aid of human or mechanical operators, as the case may be, bears the same relation to the telephone business as does the merchant's stock in trade to the merchant's business; the privilege of being able to communicate to others in a marvellously short space of time one's thoughts, together with the attendant convenience is the stock in trade of the telephone company. *It has nothing more to sell.* The merchant has his clerks; the telephone company has its clerks also and calls them operators.

The only difference between these two forms of business is that the telephone company must always build its structure (meaning its system) while the merchant need not always make this investment initially, as he can find a building suited to his purpose, rent it and then order in his stock and buy the building out of the profits.

Having drawn an analogy, let us see on what basis comparatively the two sell their commodities, and later deal with some of the peculiarities of the two forms of business.

In the earliest stages of barter the selling value or price of any article was arrived at by adding to its cost a commission called profit. This method prevails in almost every form of *business.* "Business" being but a conveyance by which to promote individual or corporate welfare, it is reasonable to assume that without the incentive of profit the conveyance may as well be abandoned.

All know that the successful merchant gives as much if not more attention to buying than to selling his goods, but he must sell in large quantity to be able to buy likewise and thus gain an advantage in the way of profits. It is a fixed rule almost without exception, that the heavier he sells the more money he can make, because of his ability to thus buy more cheaply. In the telephone business we have a condition exactly opposite and one which has caused bitter disappointments to many telephone investors. For instance, a company starts business with 500 telephones in service, this service being of such a character that each one of the 500 has 500 (for convenience actually 499) possible calls, therefore in this sized system there are 500 x 500 or 250,000 possible connections. The rate at which the service is to be sold is usually based upon what it is calculated to cost, to serve 500 telephones.

The experience of almost every company in the business, Independent or Bell, has been that they had underestimated the possible growth of the systems. The exchange which started with 500 telephones, we will assume, has grown to 1,000 telephones, but instead of the possible connections having increased in proportion, which would give us 500,000, we actually have 1,000,000 possible connections. Thus it may be seen that in the telephone business when the manner of selling service is based upon the telephone as the unit instead of taking the connection as a unit, the greater and more valuable the service becomes to the subscribers, the smaller becomes the profit to the company, and as has been shown in some reports which the Bell company has caused to be circulated in the effort to discourage capital in Independent investment. A company may prosper in point of numbers of subscribers, and yet get to a point where it is actually losing money. A merchant who would offer to his customers the privilege of taking their year's supply of sugar for any fixed amount; the railroad that would give for a fixed price a ticket good for a year's unlimited travel by the recipient, who in turn could let others ride on it when he was not using it; an express company that would carry all your express packages for a year at a fixed price for the year's expressage, would be regarded by anyone as employing questionable methods in the conduct of its business, yet we see telephone service sold on just this basis, and by reason of the fact that it has so long been the custom, few people stop to draw the comparison. The writer has often wondered how early telephone managers or those who framed the policy which formed the basis of selling telephone service, came to make the error of having the instrument the unit of charge instead of the call. This may be accounted for from the fact that when the first rates for telephones were made, the few instruments then in use were on private or club lines, which offered but one plan upon which to base the charge, that being the fixed rate, or privilege plan. Then, as the switchboard was developed and it became possible to give exchange service, the method of charges was not changed, as should have been done at that time.

The Buffalo and San Francisco Bell exchanges gave a large amount of measured service in the early days of telephony and have continued the practice. The fact of the Bell companies being able to get almost any price for a telephone while they held the field exclusively may be an additional reason for their continuing the practice of privilege telephones, though the fact that they are now the strongest advocates of the message rate plan would lead to the belief that they have awakened to their original error, and as a result have been able to profit thereby. An article from the Boston News Bureau, a financial sheet said by some to be a favored channel of Bell sentiment, contains the following:

"The Bell people tenaciously cling to the theory that the ideal service is that which puts the largest number of people into intercommunication, and charges only on the basis of service rendered.

"This ideal state of affairs has not been reached, but is the end toward which the company is aiming. At present the largest users of the telephone are getting their service relatively cheaper than those who are obliged to pay the same flat rate, but who only make occasional use of the service. This inequity the Bell people are seeking to overcome.

"The Independents are not striving to place the small man who cannot afford a telephone in touch with the man who can, but cater

only to those who are able to pay the flat rate of $48, or whatever the rate may be. The $180 flat rate of the Bell company is admittedly unjustly too high to the man who has only an occasional call a day, but it is just as truly too low for the man who has 100 calls a day."

This statement was addressed to investors in Bell securities, but in view of that company's record, as judged by past performance, it looks somewhat inconsistent, their fault lying in their past practice rather than in the present policy. The Bell companies have had the whole stage to themselves until the last few years, when the expiration of the monopoly given them by the patent office expired. They conducted the performance and handled the box office receipts, and when other shows are bidding for public favor they have begun to change their practice to conform with their policy.

They have started at the top of the list. In New York they sell almost all of their service on the message basis, recording it by meters located in the central offices, a plan that causes some friction between the collection departments and the public. The rate is ten cents per call, and in Chicago they have close to 60,000 five-cent machines. In Chicago the bulk of their service is sold through five-cent coin machines. It is almost impossible to get a telephone on any other plan. The Bell company in Chicago would rather take a contract for this service with a guarantee of six nickels a day, which amounts to $110 per year, than one for a flat rate telephone at $175 a year, because it is almost certain to produce better returns from the fact that other nickels are deposited by outsiders, who would otherwise be deadheads.

The manner of dispensing long-distance service by both Independent and Bell telephone companies has always been on the message basis, with the exception of a few small companies, which give free toll service to exchange subscribers as an additional inducement to build up their business. But this practice is being discontinued, as it is found impossible to maintain toll lines with the revenue derived from the local service only, which in itself is in many cases insufficient to properly care for the local system.

It is an indisputable fact that the greater the local development the greater will be the use of the long-distance service. For every telephone added to the local systems there is an additional possibility for the use of toll service. People who never think of making an out-of-town call until they have a telephone in the house make use of the toll service to some extent. At some time or other each telephone becomes a feeder to the long-distance service to some degree, and this is one good reason for getting as great a local development as possible.

The Independent companies have, as a rule, clung to the conventional practice of soliciting new business, but have gained in most of the smaller towns on the Bell list by virtue of public spirit and superior apparatus, the gains being made before the old companies awoke and gave their exchanges at correlative points new equipment.

The methods of advertising used by the telephone men in general, with but few exceptions, are susceptible of improvement.

The telephone can be made to so fit into the relationship between the merchants and the buyers of the household needs that when the way is known and the practice has become standard it will be a matter of wonderment as to why it was not done sooner. When we reflect, however, that the telephone business is a young institution that has developed beyond the expectations of the most optimistic, there is small cause for wonderment that it has not settled down to final methods.

In making predictions for the future it is always well to have in mind past developments, especially when we remember that even in Chicago only eight years ago the management of the Bell company was not planning for anything greater than 75,000 telephones. The company had in June, 1900, 23,340 subscribers' telephones in service; in June, 1903, it had 65,481; February, 1904, 76,618, and in October, 1904, it claimed 116,000 in its system, which would mean about 96,000 in the city of Chicago. The New York Telephone Company has had about the same experience.

The observer will ask, Why this phenomenal increase in so short a period? Aside from any matter of detail the answer can only be, because they have come to the realization, or at least put in practice that article of truth, that "the ideal service is that which puts the largest number of people into communication and *charges only on the basis of actual service rendered.*"

Each telephone added to a system makes the service the more valuable to those already connected. At this point it might be well to draw another analogy: A representative of an advertising medium comes to me and wants to sell me his service. The first question I ask is, What is your circulation? Upon his answer I have the idea of the value of his service to my company, and also upon his circulation he must base his charge to me if I want his service, and as his circulation increases both he and I know that the charge will increase, when the increase has reached a certain point, and might increase to such a point that for some people it would become prohibitive in price.

In the telephone business we have some companies which, after knowing of the trouble encountered by others in raising rates as their circulation (meaning number of telephones) increased, in getting their franchise wisely had their rates based upon the number of telephones each subscriber had the privilege of calling.

This is a step forward, but is open to fault nevertheless, in the fact that the prices asked for the privilege of having a telephone might become prohibitive to the small user, if a large development were had. The development, however, is restricted by reason of the peculiarity of human nature. That people will borrow, and every manager of a telephone exchange knows, they do borrow, or, to put it properly, they appropriate not so much from the other subscribers whose telephones they use gratis, but from the telephone company, as it costs a definite amount of money to handle a call, and if that call does not produce any revenue someone loses.

If the burden fell back upon the subscribers, as it does in a measured service telephone system when the deadhead uses the telephone, the matter would have rapid adjustment. But the average subscriber regards the telephone as the thing he pays for, giving little thought to the service. He does not regard the gas pipes and gas meters in this way, and why? Because every month he is reminded of so and so many feet of gas at so and so much per.

When one gets on a street car he does not feel that his nickel which he pays buys him any interest in the car, but knows that it entitles him to ride as far as the car goes. It is incumbent upon the telephone man to help change the views of telephone patrons as to this point, by making them regard the service as that which they pay for instead of the telephone, which is only the instrument by which the service is given. This can only be done with any degree of certainty by having them pay for the service and not for the telephone. The greatest obstacles that arise in trying to make this change are the doubts of the telephone men on the point of how to go about it. Quoting from a letter which the writer has received is the following: "Whether or not *any* scheme of measured service can be worked in this town is a matter of doubt to us."

From another: "We fully concur with your views, but do not feel that the people will take to it when now it only costs them $1.50 per month for a telephone and they use it all they wish." Another says: "It would not, we think, raise our revenues from our present subscribers materially, and even when they found that they were paying

in more money on the measured service they would likely wish to go back to flat rate." Another says: "We are operating 160 telephones, about half business at $3.50 and half residence at $1.50, and sorry to say, unable to make any money. Let us hear more about measured service. We are from Missouri, though our letter does not bear that postmark."

There are various ways of answering the questions and covering the doubts expressed by these telephone people, and it simply comes down to the question of what is the simplest and most effective way, and as there are few who do not believe in a thing when it is shown to them, the writer has believed that the best way is to make actual examples in towns of various sizes to show that the people will recognize measured service if properly presented to them.

Within a very short time such examples may be seen, and, without doubt, a general change will take place, putting the telephone man in a position to sell his service upon as satisfactory a basis as do the merchants who sell service in the form of tangible articles of value.

WHAT! UGLY HELLO GIRLS!

"Unless telephone girls stop getting married," said an official of a metropolitan telephone company, "an advertisement worded like the following will shortly have to be inserted in the newspapers if new operators are to be obtained:

WANTED—Energetic telephone girls; must be homely; none other need apply.

Marriages of telephone girls in the various exchanges in the greater cities are said to be on the increase. If the weddings keep up through the coming fall and winter some of the officials believe there will be a scarcity of good operators, and that homely girls will have to be advertised for in the hope that their lack of attractiveness will prove discouraging to prospective suitors. No way has yet been discovered whereby the approaching marriage of a telephone girl can be made known quickly enough to permit the retiring operator of the switchboard to "break in" a new girl in her place.

"Take my word for it," said the head of this same telephone exchange the other day, "the marrying off of the telephone girls is carrying into untimely graves the telephone men generally in the larger cities of the United States. Incidentally thousands of subscribers to the telephone service are in danger of death from apoplexy or other diseases brought on by worriment over their telephone service when a new girl is at the other end of the wire.

"Yes, you laugh," smiled the manager, "but, honestly, this marrying off of our girls is one of the hardest things we have to contend with. You see, it's like this:

"A telephone company gets holds finally of a first-class set of women operators, everything then is running along smoothly and everyone in the office is comparatively happy until suddenly a whole contingent of the girls wend their way to the side of the chief operator and haltingly and with many blushes gently break the news that the coming Saturday night they will have to be excused—that, in other words, they have the buzzing bee of matrimony in their bonnets, and intend forthwith to quit the service. Very often when a girl gives notice of her intention to retire she hedges when asked the reason why. But the chief operator, with the wisdom born of long experience in the ways of women, and especially telephone girls, knows the meaning of equivocations and the blushes.

"The one in charge of the exchange looks ahead. To him it means, as a general thing, a breaking down of the almost perfect system, apoplectic subscribers, chaos within and outside of the office, and misery for the beginner who takes the seat just vacated. Anathemas are frequently hurled at the officials of the telephone company, as well as at the operators along the humming wire, by various indignant folk; nail after nail is thus driven into their coffins, and it is thus that their span of life, I believe, is sometimes shortened."

TRIAL BY TELEPHONE IN TEXAS.

An interesting tale, having to do with the telephone, a bad boy and the theft of a gum-vending machine by the aforesaid bad boy, came to light at Temple, Texas, a few days since by the arrest of the boy. During a fire that occurred several weeks ago a gum-vending machine was stolen from the front of a local drug store. Liberality in treating is what led to the culprit's downfall, for it was but a short time until the officers were informed that Harry Price, a noted bad boy of the town, had more gum than his pockets could hold and was dispensing the same with reckless prodigality among his followers. It took but a few minutes to run Harry to earth and not much longer than that to get a full confession. In fact, he got sorry so fast for his misdeeds that he offered to pay for all the gum. When the last ray of hope was gone young Price became sorry still faster and announced his intention of pleading guilty by telephone, Belton, the county seat, where presides the judge of the county court, being eight miles away. So it was arranged, in order to expedite matters and accelerate his confinement, that a telephone plea would be accepted. The judge accordingly took up his receiver at the Belton end of the line and accepted the plea of guilty, then, by the same medium of communication, he wafted back the penalty, thirty days in jail and $25 fine. Ringing off on the Temple line, he called up the sheriff's office to notify him that the commitment papers were ready. The latter official, in his turn, rang up the superintendent of the county farm and instructed him to get ready to receive a new boarder. That official was at a distant point on the farm when he got the message through a local telephone, which he used to ring up the farm and order his assistant to prepare for the lodger. That worthy replied that he would, and so the word was sent back by telephone to the superintendent, the sheriff, the county judge, to the officers at Temple, and finally communicated to Price. Thus the whole transaction, which involved the prisoner's liberty for thirty days, was transacted by telephone messages. This is the first case, so far as known, where a prisoner has been virtually telephoned into jail. And it was all done at the prisoner's request.

ADVERTISEMENT BY TELEPHONE.

The scheme of utilizing the telephone in connection with its advertising is said to have originated with a Chicago publication, which established offices at various parts of the city from which an advertisement could be left and paid for just the same as at the main office, but the most up-to-date refinement of this idea was developed in the east. At Wilmington, Delaware, an arrangement has been made by a newspaper with a telephone company by which any of the slot instruments of the company in that city may be used for the transmission of an advertisement to the office of the particular paper referred to. This is a great convenience to those desiring to insert want and other small advertisements. It is only necessary to call up the newspaper office and state what is wanted, when the clerk will direct the would-be advertiser what amount of money to place in the slot. This formality having been complied with, the advertisement is read to the clerk and copied by him and duly inserted in the paper.

The Telephone in Foreign Countries

INTERESTING LONG-DISTANCE EXPERIMENTS.

SOME very interesting experiments are now in progress in the general postoffice in London, which promise a very considerable increase in the present telephone facilities between London and Birmingham, Manchester and Liverpool. The underground cable, which has been working to Birmingham for some time, has now been extended to Manchester and Liverpool.

One of the main objects which it has been the object of the postoffice technical staff to achieve has been to utilize the cable for telegraph work, in order to liberate the overhead trunk lines for telephone communication. This object has been brought appreciably nearer by the present series of experiments.

By means of the introduction of what are known as "resistance bridges," and the use of "primary" batteries on one circuit and "secondary" on the other, it has been found possible to "superimpose" a duplex circuit on a cable loop, which is already being used for quadruplex working. This increases the number of working channels of such a loop from four to six, and liberates another overhead trunk line for telephone work. Between London and Birmingham it has even been found possible to "superimpose" a second quadruplex, increasing the channels from four to eight, without any new trunk lines being used."

The new system is due to A. M. Martin, a second-class technical officer of the engineer-in-chief's office, and at one time a telegraph operator.

TELEPHONY DURING THUNDERSTORMS.

The experiments made in the direction of maintaining an uninterrupted telephone service during the prevalence of thunderstorms in the Berlin telephone area are reported to have yielded favorable results. It was sought, first of all, to limit the service under such conditions to offices Nos. 1 and 3, which are connected by means of underground cables, but this was found impracticable, and it was therefore arranged that a continuous service should be undertaken at all the offices in Berlin. At the same time the postoffice authorities prescribed that connections should be suspended at those exchanges which still have overhead wires, insofar as the storms manifested themselves within the districts of those exchanges.

In some cases it is considered that sufficient precautions were not taken in this respect in the past, as many telephone girls suffered as a result of electric discharges. Such accidents have, however, not occurred during the past summer, as the suspension of the service has been more rigorously carried into effect on the approach of a storm. This arrangement, which also will be enforced next summer, will be materially facilitated by the expectation that the transformation from overhead to underground lines will have been completed by that time in connection with offices Nos. 4, 6 and 7. It is said to be impossible to entirely change over from aerial to underground cables, owing to the refusal of property owners to allow the pipes to be laid through their gardens.

MUNICIPAL TELEPHONY IN HULL, ENGLAND.

The construction of a municipal telephone system in Hull has brought about a speedy reduction in rates. At a recent meeting of the corporation telephone committee it was announced that the charge for unlimited service over an exclusive line would be £5 ($24.33) per annum to private houses and £6 6s. ($30.65) to business premises. This reduction has been followed by a large increase in the number of subscribers. The National Telephone Company has been compelled to reduce its rates for unlimited service, so far as regards private houses, from £10 ($48.66) to half that amount. To what extent this reduction will affect the company in other towns and cities is a matter of interest.

It is stated that in the agreement which the National Telephone Company has with practically all the large towns and cities in England, and by which the corporations of those towns granted the company underground way leaves, it was made a condition that in case they reduce their unlimited service rate in any place below $48.66, a similar reduction must be made, if demanded, in all other towns. If this is the case, then other cities can now demand the same telephone rates as is made in Hull. Thus the competition in this city may prove beneficial to every city in England.

LONDON UNDERGROUND TELEPHONES.

During the year 1904 the general postoffice engineers made rapid progress with the extension of the underground telephone system. The cables are in working order as far as Hampstead, in the north, where a new exchange has been opened, and the work is being pushed forward a good deal further in that direction. A new exchange has also been opened at Croydon, in the south; and westward the system has been extended to Kingston-on-Thames, but in the east not beyond the city boundaries. Eleven telephone exchanges have been opened up to date, and call offices innumerable. At the end of November, 1903, there were 13,500 subscribers, and now there are 21,400—a most satisfactory increase of 7,900. The system will ultimately cover an area of 640 square miles. Operations were commenced on the Victoria Embankment on March 31, 1902. The estimated cost of the enterprise, which has proved of immense advantage to the industrial world and commercial men, as well as the general public, was £2,000,000, but that amount will be largely exceeded in consequence of the unforeseen difficulties experienced in digging the trenches, laying the cables and making diversions from the original plans on the route of the service. There is inter-communication between the postoffice service and the National Telephone Company's system, whose trunk lines extend throughout the country.

THE TELEPHONE AS AN ALCOHOLOMETER.

It is stated that M. Meneuvrier, assistant director of the Laboratory of Researches of the Paris Faculty of Sciences, has just discovered an infallible method of ascertaining by the use of the telephone how much a given quantity of wine has been watered. The principle on which the invention rests is the variable conductivity of different liquids.

The apparatus is described as follows: Two vessels, one containing wine known to be pure, the other the same quantity of wine to be tested, are placed on an instrument outwardly resembling a pair of scales. The telephone is in contact with both liquids. If the sample of wine under observation is as pure as the standard used for comparison no sound is heard; if, on the contrary, it contains water, the tell-tale telephone "speaks," and the greater the proportion of water the louder the instrument complains. A dial on

which a number of figures are marked is connected with the telephone.

To ascertain the proportion of water in the wine tested, the operator moves a hand on the dial until the telephone, which has been "speaking" all this time, relapses into silence. The hand has thus been brought to a certain figure on the dial. This number is then looked up in a chart which the inventor has drawn up and corresponding to it is found indicated the exact proportion of water contained in the quantity of wine.

M. Meneuvrier's remarkable invention can, he says, be easily applied to the testing of many other liquids and even solids, which may be adulterated by the addition of foreign matter possessing a conductivity different from that of the original substance.

TELEPHONES AT VILLAGE POSTOFFICES.

An important experiment, which may have far-reaching results, is being made at the present time in Great Britain by the telegraph department of the general postoffice in half a dozen villages. The object is to ascertain if it is practicable to make village postoffices serve the purpose of public telephone call offices. If successful the result will be the removal of one of the disabilities attaching to life in villages.

For the past six years, although the fact is not generally known, it has been the practice to use the telephone, which officially is a telegraph instrument, to transmit telegraph messages from town centers to small village postoffices. The installation of a telephone wire is cheaper than the telegraph installation, and the messages can be sent more expeditiously than by the needle instrument or the A B C code, the methods generally used in village postoffices. The messages are written out and stamped by the sender and are sent over the wire by the clerk.

In the selected villages it is now possible for any member of the public to ring up a subscriber and use these postoffice telephones in the ordinary manner at the ordinary rates. Should the person with whom communication is desired not be on the telephone line the sender can telephone his message to the nearest postoffice and have it sent on by express messenger. In the case of long messages the saving in expense, as compared with sending the same message at telegraph rates, will be very considerable. Similarly, the town dweller will be able to communicate with the villager.

THE TELEPHONE IN MEXICO.

The construction of a telephone between Teocaltiche and San Juan de los Lagos has recently been finished.

Telephone linemen are busy in Juarez making the service in that city as up-to-date and efficient as it is in El Paso, Texas, just across the Rio Grande river.

A private telephone system to connect the National Palace, Chapultepec Castle, and the private residences of President Diaz in the City of Mexico is to be installed under the direction of Oliver L. Araiza, an electrical engineer.

The Richardson Construction Company of Los Angeles, California, has been organized with a capital stock of $500,000 for the purpose of undertaking telephone construction in various parts of Mexico.

All the telephone lines in the state of Yucatan are to be thoroughly repaired.

On December 1 the telephone system from Tlazazalco, to Pureparo, Michoacan, was inaugurated.

TELEPHONY IN CANADA.

At a recent meeting the board of control of Toronto decided to call on telephone companies to put in tenders within a short time for the installation of an Independent telephone service, on their own specifications, if not on the specifications drawn up by the board. Controller Hubbard advocated the idea of petitioning parliament to sanction the taking over of the long-distance lines by the government.

The Stark Telephone, Light and Power System, Limited, has completed its automatic telephone system at Toronto Junction, Ontario. The company already has more than 250 subscribers, and this alone insures the success of the enterprise.

Among the latest experiments which are being undertaken by the Canadian Pacific Railroad for the improvement of its service, is the composite telephone. This is a new system, by means of which telephone and telegraph messages may be sent over one wire at the same time, without hindering the efficiency of either instrument.

The Ontario Independent Telephone Company has been granted a franchise by the Amhurstburg council. The Bell people put up a bitter fight against the new concern. The Independent company has a number of franchises in Essex county and will soon have its lines in operation.

Steps are being taken to establish a rural telephone system in the county of Waterloo, Ontario, and a company with that object in view is being organized. The system will probably be operated by the municipality of Waterloo.

The St. John, New Brunswick, city council has approved a proposition either to install a system of its own or negotiate with another company to enter the field and compete with the New Brunswick company, whose rates have been increased and are declared to be excessive. The question is now under further consideration looking toward final action.

The Edmonton (N. W. T.) district telephone system has been purchased by the city of Edmonton. The system includes four exchanges, namely: Edmonton, Strathcona, Fort Saskatchewan and St. Albert, with a capacity of 425 telephones. There are also other lines owned and operated by the same company.

Notice has been given that application will be made at the next session of the legislature of the province of Manitoba for an act to incorporate a telephone company with power to construct, establish, equip, maintain and operate local and long-distance telephone lines within the province.

The Stark Telephone, Light and Power Company has submitted terms under which it will construct an Independent telephone system in Toronto. It proposes to give the city the right to take over on six months' notice the assets of the company at any time during the twenty-one years' franchise, and to charge for business telephones $35 and for residence telephones $18.

CONTINENTAL TELEPHONES.

Since November 15 last, telephonic communication between Switzerland and Luxembourg has been open via Strassburg-Metz. The interested states have agreed that there shall not be more than five intermediate stations, the terminal offices included. The charge is four fr. for a conversation of three minutes. For the purpose of establishing telephonic communication between Würtemburg, Bavaria and Switzerland, the administrations of posts and telegraphs of the two former states have proposed to lay a telephonic cable across the lake of Constance, between Romanshorn and Friedrichshafen. The Swiss administration has notified the German states that the necessary funds have been provided for in the budget for next year to meet one-half of the cost of the undertaking. The class of cable to be laid has not yet been decided upon, but the outlay has been based on the cost of the telegraphic cable already laid across the lake. The Würtemberg administration has undertaken the laying of the cable.

TELEPHONE NOTES FROM ABROAD.

Telephone operators in England have formed an association for the protection of their interests. They ask for a

minimum wage, a larger salary increment, a better system of promotion and improved sick-rate payment.

A new telephone line has been constructed between Paris and Rome. Tests of the wire have proved highly satisfactory.

The isophone is a new telephone transmitter brought out by a Belgian. It transmits the quality of sounds faithfully, whether of the voice or of musical instruments. The carbon grains forming the microphone are inside a bag of leather or parchment, which is vibrated by the diaphragm and the sound. A small piece conveys the vibrations from the diaphragm to the bag, something like the hammer bone of the ear.

A new telephone exchange, which is about to be established in Berlin, will be equipped with the Strowger automatic system, which is workable to the extent of 100,000 connections, having been tried in Germany since 1900 at a central station with 4,000 connections, equipped by the Automatic Electric Company of Chicago. The German government has since acquired the sole rights of installing the system in the German empire.

Up to 1887 there was not a single public telephone in Japan. The first systems were installed in 1890. At the end of 1901 there were 179 public stations, with twenty-five city systems and 25,000 subscribers, while as many more were demanding telephone service. The Japs are capable of "hurricane fighting," but also capable of hurricane progress. In 1871 there were 19,000 telegrams sent; in 1881, 2,586,000; in 1891, 4,674,000, and in 1901, 16,221,000.

According to the *Telegraph Chronicle* of London, there is no question that the English public has lost faith in the telegraph service of that country, while the telephone is making marvelous strides and is becoming more popular each day with the Britons. Delays and errors have robbed the telegraph of efficiency in England. The merchant will not trust the postoffice with an important message, knowing first of all that it will be a long period before it reaches its destination, and that when it is received it will be hopelessly mangled, while with the telephone exactly the opposite is found to be the case.

GOVERNMENT TELEPHONE SERVICE.

In one of the appropriation bills passed by the last congress, Bernard R. Green, superintendent of the library and the new museum at Washington, was instructed to submit plans for a central power station, to be located downtown, in the neighborhood of the treasury, for the purpose of supplying heat, light and power to the White House and the department buildings. Mr. Green's report is nearly finished and will be ready for the consideration of congress early in the new year. It contemplates a plant which will cost about $1,250,000 and will include an exclusive telephone service for the use of officials of the government. At present this service is supplied by a private corporation, and all of the wires run through a central station, so that the president cannot talk with the secretary of state nor with the speaker of the house without being overheard by others. It is proposed to concentrate all of the government telephone wires in the proposed power plant, with connections between its central station and the regular public exchanges.

According to the calculations of Mr. Green, more than $100,000 a year may be saved in heating and lighting the executive departments downtown, and this economy will be doubled when the new museum, the new agricultural department, the hall of records, the municipal building and the new departments of state and justice buildings are completed. A power plant capable of supplying heat, light, power and telephone service for all of these buildings can be erected for $1,250,000, including machinery, and will thus pay for itself on present expenditures in ten years, while the economy will still go on increasing as new buildings are erected. The economy in the cost of furnishing light, heat and power plants for the new buildings alone will pay for the central station, and thus not only will a large sum of money be saved, but the space occupied by machinery in the existing buildings and proposed buildings can be devoted to other purposes.

ELECTRICITY AS A CAUSE OF FIRES.

The electrical bureau of the National Board of Fire Underwriters recently made a report on the number of fires caused by electricity for three months. There were 145 fires with losses aggregating over $172,000. Thirty-three fires especially mentioned in the report were due chiefly to grounding, short-circuiting, destroyed insulations and defective wiring. Twenty crosses of telephone, telegraph and other signaling circuits with lighting and power circuits were reported. Twelve fires were caused by dynamos and motors, in eight cases due to burning out of armature or field coils. Twenty-seven cases of grounding of circuits are reported, twelve of which were on awnings and metal work of buildings. Five fires were caused by short-circuiting in flexible cord, due chiefly to the use of defective commercial cord with poor insulation, and to the wrapping of the cord around pipes, nails, etc. Six fires were reported due to short-circuit of wires in fixtures, four by short-circuit in watt-meters, one of them being the old-style chemical device. Four fires were due to the use of openlink fuses in defective porcelain cut-out blocks. Five fires were caused by the heat of incandescent lamps located near inflammable material. Twelve reports of damage by lightning were recorded. In a number of these the lightning entered the building over the lightning or signal wires, which were not properly protected.

EARS AND HELLO.

When a telephone operator hears somebody crying "hello" to her on the street, nine times out of ten she ignores the greeting. Why? Because she takes the salute to be a delusion. A girl who day after day hears "Hello, hello, hello," dinned into her ears, and who is constantly responding with "Hello, hello, hello," in time grows to hear and repeat the word mechanically, and when she leaves her work that word is still ringing in her ears. She can hear people saying "hello" to her on all sides, but the greeting of the real thing is so confused with the ghosts of dead labor that she seldom notices the first salutation of a friend.

And did you ever know, by the way, that nine out of every ten persons who habitually use the telephone have what is now called "telephone ear?" In its first stage the telephone ear becomes acute and sensitive, but after long use the hearing becomes more or less blunted, and half the complaints against poor telephone service may be attributed rightly to the "telephone ear." Try it some time. If you habitually use the left ear, next time use the right and see if it isn't twice as satisfactory. It is a good plan for those who use the telephone much to frequently switch ears. This keeps the hearing equally balanced and might ward off a permanent deafness.

The Baltimore & Ohio railroad is contemplating the introduction of a telephone system along its lines, to be operated in conjunction with the telegraph system in the running of trains. On some of the western sections of the road the telephone is in use now, and it has been found to work most expeditiously. The matter will be decided very shortly, as plans that have been formulated by a committee of the Baltimore & Ohio telegraphers and some of the high officials of the road will be laid before President Murray for his approval.

More Powerful Telephone Transmitters

C. ADAMS-RANDALL.

C. ADAMS-RANDALL.

I have just finished reading my December copy of your journal and want to say *en passant* that this number is exceptionally interesting, a great production, in fact, full of information and valuable reference that should be appreciated, not only by your subscribers, but by all interested in electrical matters. The paper by Mr. McMeen on "Phases of Long-Distance Telephony" is of especial interest just now, as it is very complete as a general presentation of a subject which is becoming more and more important. The more we can learn about this application of the telephone, the sooner we will have Puck's "girdle around the world" for talking over. Mr. McMeen has very cleverly diagnosed the situation, and suggested certain remedies to be administered. I am fully in accord with Mr. McMeen in his conclusions, namely, that to insure the greatest good to the greatest number, we must have, as he states:

A. Cheaper line circuits.
B. A successful telephone repeater.
C. More powerful telephone transmitters.
D. Multiplex telephony.

These suggestions have inspired me to write this article, which I commence by stating that the medicine I would prescribe is contained in one bottle, and labeled "more powerful telephone transmitters." This, in my opinion, is the key to the situation. It will unlock the secrets and solve the many problems of the telephone, increase its utility and efficiency, and renew its life and usefulness.

With this apparatus perfected, all of the other requirements fall into line easily and naturally. I know just a little about telephony after twenty odd years practical experience, and I am still learning. From what I do know, however, I believe that, in combination with the use of the best granular transmitters, before we can have "cheaper circuits" for long-distance service, a successful "telephone repeater" in practical use, and "multiplex telephony" over any distance, we will be compelled to endure much weary waiting. These problems, however, are certain to be solved, together with, in addition thereto, the automatic recording of telephonic messages, telephonic-telegraphy and wireless telephony.

The telephone repeater is practically impossible to-day, because the available current energy at the receiving end of a long circuit, with the best granular transmitters known, is barely sufficient to operate the most delicate electrical instrument extant—the perfected magneto-receiver—much less actuate an electro-mechanical apparatus, which, in turn, must become an automatic telephone transmitter, or operate a second transmitter automatically, to control a second battery, and the currents or impulses over, in, or upon a second circuit. This inherent defect or weakness of the present granular transmitters applies with equal force to the constructing of cheaper circuits. We all know that to overcome the resistance of distance, leakage, induction, etc., most expensive copper wire metallic circuits are absolutely necessary, such as, for instance, the long-distance circuits of the American Telephone and Telegraph Company, the New York Central railroad and others, and that even with these almost perfect circuits the commercial results are not any too good, especially if there are any intermediate stations. Further than this, a most important feature not to be overlooked is that the use of such circuits as these, instead of being a commercial business convenience, are, in a sense, an expensive luxury, positively prohibitive to the great majority; and this condition must remain so long as such costly circuits are necessary and long-distance telephony is in the hands of a monopoly. It occurs to me, at the mention of "monopoly," that the Independent telephone companies have been and are doing a great work for the people, with reasonable profit to themselves, in their competition for a proportion of this great telephone business. It now only remains for them to complete and extend their undertaking by interconnecting their toll lines for long-distance service, introducing more powerful transmitters and recording telephones, and they will be certain of the greatest success possible, and will have earned, and should receive, the hearty co-operation and patronage of all thoughtful, careful, enterprising business men in this great country.

To return to the subject of the "more powerful telephone transmitter." These are simple words, not at all impressive, and do not convey the thought of anything revolutionizing, seemingly, referring only to a simple, inexpensive apparatus for transmitting speech. If we stop to consider, however, what these simple words mean, and to analyze them, we will learn that they refer and apply to a means of intercommunication that is as far reaching as, and more rapid and much less expensive than, the telegraph of Morse, and realize then that it is a revolutionizing electrical device. Why? Because:

1. Owing to increased initial current output, it means better transmission over increased distance.

2. The cost of long-distance circuits of copper or other material will be reduced at least fifty per cent.

3. It will permit of the use of telephone repeaters in circuits of greater length than used with telegraph repeaters, whereby messages can be repeated automatically from the primary main line circuit into a second circuit with an automatically added current energy equal to that in the first circuit. Further, this being true, this action can again be adapted to repeat messages on and on, and as many times as may be necessary, so that land lines of almost any distance can be operated over, and by the use of say four to six repeaters, telephony becomes practicable from Maine to San Francisco, or Texas, and without requiring the present expensive circuits.

4. Having solved the problem of operating a repeater, actuated electro-mechanically, it is but a step further to an electro-mechanical telephone-recording apparatus, which will record all telephone messages automatically and independently, or simultaneously with receiving in the usual way.

5. Single grounded iron telegraph circuits worked direct telegraphically by manual means can be worked simultaneously with the telephone, thus more than doubling the value and usefulness of a telegraph circuit, plus the convenience and reliability of the telephone. For railroad uses, this becomes a most important factor, facilitating business and aiding in the dispatch of messages on overcrowded circuits. (See the article on "The Telephone on Rail-

roads" in TELEPHONY for December.) For telegraph companies it must become of great importance and value, both on main line circuits, as it can be used simultaneously with the telegraph, and on local circuits for dispatching messages to a main office from sub or branch stations at increased speed and decreased cost. And also for use at small offices where the expense of a skilled operator is unprofitable.

6. It will solve the problem of telephonic telegraphy, i. e., the transmission by telephone of social and business messages, through the medium of special telephone operators, as is now done by manual telegraphy and telegraph operators. Given a reliable, effective, powerful telephone transmitter applicable to use over long distances, with or without the combination of a repeater, or automatic telephone recording apparatus, it only becomes necessary to carry out this branch of telephony, to have a central office where expert telephone operators are employed for receiving and transmitting messages. Such central office or offices can be connected to the regular telephone subscribers in cities and towns, or connected to sub-stations connected to such subscribers. Every subscriber, or thousands of them, become at once collectors of messages or operators without pay, and, in fact, I am not certain but that they would gladly pay something for each connection, as it will be to their convenience and advantage, and cheaper and far more expeditious than the present messenger call system. It also means to the telephonic-telegraph company an increase in speed in collecting from the sub-stations of from four to eight or more times, or as twenty words per minute, a fair average Morse key transmission, is to a rapid writer, or as, to 100 or 150 words per minute taken down by a shorthand writer, or by automatic telephone recorder. The re-transmission to destination and delivery by telephone will be far more expeditious and less costly than by telegraph methods, and it is not extravagant to contemplate a reduction of from forty to sixty per cent in the cost of sending messages.

7. It seems possible and probable that such an apparatus will be adapted to ocean cable telephony with an increase of speed at least double that of telegraphy, which should mean a corresponding reduction, more or less, in the cost of cablegrams.

8. The problem of wireless telephony can only be solved by the aid of this class of apparatus.

9. In the near future the more powerful transmitter and its accompaniments must take the place of the manually operated telegraph for the transmission of a certain class of social messages.

To summarize: The "more powerful telephonic transmitter" means the solving of the many problems in telephony, a more extended and less costly use of the telephone, and its application to many purposes for which the telegraph is now used.

With the exception, possibly, of automatic or rapid telegraph systems for press news and special service, the telephone foreshadows the abandonment of the slow, full-of-mistakes, guesswork, costly telegraph of to-day, for the up-to-date, advanced, convenient, speedy, reliable, low cost telephone system, and just as certain as that the granular transmitter has displaced the "magneto," the "Blake," the "dial" and the private line "printing telegraph."

It is barely a score of years since telegraph and other experts were saying, "The telephone is a wonderful toy," "It may be used on short circuits, but a hundred miles—never," "It can never affect the telegraph," etc. We all know how far wrong were the opinions of these wise ones.

The British telegraph report for the year ending March, 1904, shows that the telegraph receipts continue to suffer from the growing use of the telephone; that the falling off in the number of telegrams last year was 2,500,000; that the average value of each telephone connection was over 70 cents. This, in a country where telegraph messages are sent for twelve cents, would seem to show that cost is not so an important a question as promptness and reliability.

Considering the wonderful growth of the telephone, its many applications and adaptations, and its possibilities, it is more unwise to-day than it was twenty-odd years ago to say that it can not or will not supersede the telegraph. The old omnibus and stage coach in and between our cities and towns have had their day and succumbed to the modern methods of transit. Steam power, as used to-day, is fast following the fate of the others and very soon the steam railroad will be a thing of the past. The doom of manual telegraphy is equally as certain, so soon as telegraph, railroad and telephone companies and other capital is made to understand and realize the possibilities of telephony.

TELEPHONE IN CAB GUARDS TRAIN.

BY EARL C. LONG.

To Edward Rowe, a well-known resident of Indiana, Pennsylvania, belongs the credit of inventing and perfecting a new system of train operation by means of a telephone working in such a way as to keep the train in touch with the "block" office, and through that office with the division dispatcher. In addition to this the electric connection operates an "indicator" which shows the position of the train as it completes each one-fourth mile of its trip over the block.

The system has been repeatedly tested of late and a thorough examination of its working is now being made by a number of the principal operating officials of the Pennsylvania railroad. The principal tests thus far have been made on the Indiana branch of the West Penn division, and officials of the road have kept in close touch with the progress of the experiments.

Greater safety at a comparatively small expense, especially for single-track railroads, is the claim of the inventor, and the simplicity of the equipment, demanding no expert knowledge beyond that of the ordinary electrician, is put forward as another reason for its practicability.

The system consists of a telephone in the engine cab and in the office of the block operator. The office telephone is connected at all times with a wire running from one end of the block to the other on the telegraph poles. At quarter mile intervals contact rails are placed on the ties just outside the roadway rails. These contact rails are simply blocks of wood with a sheet steel or iron covering. They are connected with the wire on the poles. The engines are equipped with a telephone instrument with the wires leading to a brush on the outside of the engine so placed as to run on the contact rails.

As the engine passes each contact rail, the contact is recorded on an indicator in the operator's office and shows how far the train has progressed. If the operator desires to talk to the engineer all that is needful is for him to switch on a stronger current, which will ring the bell of the telephone instrument in the cab. The engineer will then stop his train and back up to the contact rail when he can talk to the operator. It is possible also for him to lift the telephone instrument from its hooks and carry it to the nearest contact rail, in case the engine should be disabled. The failure of the contacts to be recorded in due time would mean, barring the ordinary chances for the electric apparatus being out of repair, that an accident had happened. It would then be possible for the operator to catch any oncoming train inside of a quarter of a mile and avoid accident.

This rough description shows only the operation of the general plan, but its details have been worked out with all care.

Modern Printing Telegraph Systems

J. C. BARCLAY

MACHINE telegraphy is undoubtedly destined to play, if not a dominant, at least a highly conspicuous part, in the telegraphy of the future. For the present, and probably for a long time to come, the Morse system will continue to be the standard system employed in this country. It is doubtful indeed, if the Morse apparatus—representing as it does the very acme of simplicity—will ever be wholly superseded, but new and improved, as well as more economical methods of working, will, slowly perhaps, but nevertheless surely, limit its field of operations.

The advances made in recent years in the direction of developing and perfecting a printing telegraph system, adapted to meet all the requirements of a modern telegraph service, have been of such a practical and progressive character as to leave no room for doubt that the successful advent of such systems into the domain of commercial telegraphy will soon be, if it is not indeed already, an accomplished fact. Ever since the birth of telegraphy, the subject of printing telegraph systems has more or less engaged the serious attention of electrical inventors, and as a result of their efforts quite a number of such systems have been devised and put into operation; but until quite recently their usefulness has, with few exceptions, been restricted to stock and market reporting or other enterprises of a more or less private and local character. For the general telegraphic work of the country these systems are entirely too slow; they can only be successfully operated over limited distances, and their records are, as a rule, made upon a strip of paper which is regarded with anything but favor by the telegraphing public of to-day.

In the elements of weakness above mentioned lie the stumbling blocks to success, but of this the majority of printing-telegraph inventors appear to be entirely unconscious, judging from the way their energies are misdirected in continued efforts to develop and perfect a type of machine for which there is absolutely no demand in the great commercial departments of the telegraphic industry. Many of the more recent inventions are based upon the principles embodied in the ordinary commercial typewriter, whose peculiar adaptability to the requirements of a telegraph printer was soon recognized, and whose advent into the art may be said to have marked the beginning of the new era of modern high-speed type-printing telegraph systems.

It may be said of the majority of printing-telegraph contrivances based on the typewriter principle that they are "fearfully and wonderfully made," but a few comparatively simple ones are to be found that can be operated at speeds higher than those attainable by any of the ticker systems, while at the same time making their records in page form instead of upon the objectionable paper tape. The maximum speed at which they can be worked, and the distances over which they can be satisfactorily operated, are, however, so far below the requirements of the present telegraph service, that until they have become more highly developed along the lines indicated, their sphere of usefulness will be limited to enterprises outside the field of commercial telegraphy.

One principal source of weakness in connection with these moderately fast short-distance machines consists in the character of the signaling currents employed, which, as a rule, lack the necessary quality for overcoming the retarding and attenuating effects of the main line. Very short signaling impulses that differ greatly in strength with occasional changes in direction—as employed by some inventors—is not a current arrangement adapted to long-distance transmission. Nor is a combination of electrical impulses of one polarity and of uniform strength much better calculated to increase the signaling distance over lines of considerable inductive capacity, the tendency of which is to retard and absorb such impulses.

A much better plan to secure effective signaling is to incorporate into the system a method of reversing or alternating the line currents, and until inventors more fully realize the importance of some such arrangement, their chances for success in the direction of long-distance working will be highly problematical.

The superiority of the alternating-current method for printing telegraph purposes has already been pretty well demonstrated, and this fact opens up the interesting question as to what particular extent such currents might be utilized with advantage in the working of ordinary telegraph circuits. It is well understood that the successful operation of these circuits is seriously handicapped by certain line-disturbing elements that are more likely to increase than to diminish in magnitude and intensity as the years roll by.

The leakage interference from the ubiquitous trolley lines constitutes, for instance, one of the growing evils that beset the telegraph engineer, while more or less trouble is to be apprehended from the development and extension of high-pressure transmission lines with their immense capacity for creating inductive or other disquieting influences. It is possible to exclude the former, and to modify the effects of the latter's interference by the use of condensers directly inserted in the main line, which arrangements would also wholly or partly rid the circuit of all ground currents and leakage currents from neighboring wires, as well as minimize the deleterious results arising from defective insulation, variations of resistance, capacity, etc. Such an arrangement, however, would be utterly impracticable with the ordinary battery currents, but as the alternating signaling impulses can be easily transmitted through condensers, a combination of the character mentioned would seem to lend itself in a manner quite feasible to the practical exclusion of most of the distributing influences to which all telegraph lines are more or less subjected.

Whether or not this principle will ever find a general application in ordinary telegraph working, it is certain that the subject is receiving considerable attention at the hands of telegraph inventors, several of whom have already succeeded in making practical applications of such a character as to suggest possibilities of the utmost importance in this new and promising field of telegraphic development.

Harking back to the subject of printing telegraphs, it may be remarked that no matter what kind of transmitting current may be employed in connection therewith, a satisfactory system at the present time calls for page printing, at a high rate of speed, over considerable distances, and some few of the latest inventions pertaining to this particular art take note of these essential requirements.

The most highly developed specimens and best known examples of this modern class of machine are those invented by Murray, Rowland and Buckingham. In the Murray system the messages are both transmitted and recorded mechanically through the medium of a typewriter. A perfor-

Paper read at the International Electrical Congress at St. Louis.

ated paper tape is first prepared by means of a keyboard mechanism, and is then run through a Wheatstone transmitter which automatically, and at a high rate of speed, sends out the signaling currents to the distant receiving station. These currents are utilized, not to actuate the printing mechanism direct, as is the case with all other printing telegraph systems, but to reproduce another perforated tape, the particular function of which is to mechanically control the working of a typewriter in a manner analogous to that by which a mechanical piano may be operated by a perforated band of paper. This is a highly novel and ingenious application, since the actual printing is accomplished locally, and without regard to the signaling currents coming over the line; but the use of the perforated tape at both the transmitting and receiving stations introduces an element of delay that is more or less objectionable despite the rapidity with which the signaling currents may be flashed over the main wire.

In Rowland's printing arrangement there is no such objectionable feature, the transmitting apparatus having been designed to work directly into the line, and to operate the receiving mechanism in a manner equally direct. Direct transmission and reception is, in fact, one of the most desirable features in connection with the operation of any telegraph system, but when this is accompanied by a very large increase in the carrying capacity of the wire over which such system is worked, the latter may not unjustly be regarded as one coming well within the range of being an ideal method of working. Such, at least, are the views expressed by the advocates of Professor Rowland's octuplex system, and these views might be readily accepted if to the other admirable features of this "telegraphic wonder of the age" the great merit of simplicity could only be added.

The system is operated on the multiplex principle, and requires that between certain corresponding parts of the rotating mechanism at each end of the line perfect synchronism be maintained. Success in this direction heretofore has only been practically accomplished over very short distances with transmissions as numerous as those involved in the Rowland printing arrangement. It is claimed, however, that the difficulties previously encountered in the way of maintaining unison over considerable stretches of line have now been fully overcome by the use primarily of an alternating current continually flowing to line, which current not only provides for the necessary synchronizing impulses, but for the signaling impulses as well. The sending of the signals, it may be remarked, is actually accomplished not by supplying the line with current at the moment the signal is being transmitted, as in the ordinary telegraphic methods, but by cutting out certain of the alternating-current waves, the arrangement being such that one or more of these signals can be made to consist of a combination of suppressed half-waves, the signals so produced being then automatically translated into printed characters. In this way, and by grouping the waves in a manner admitting of entirely different and independent signals being sent from four Remington keyboards, each of the four transmitting operators employed can cut out four different wave combinations, and send as many different signals over the line in a single second. Forty words per minute is said to be an ordinary rate of speed for a practiced operator using this system, or, since the system can be duplexed, eight times that number, making 320 words in all, may be sent and printed over a telegraph wire in the course of a minute. This, if practicable under the regular conditions of working, would make the Rowland system the fastest of all printing systems, or, what amounts to the same thing, it would be capable of more fully utilizing the electrical conductivity, or transmitting properties of a wire than any other system of similar character.

That the Rowland machine has been very highly developed on the most modern and approved scientific principles is undoubtedly true, but it remains to be more fully demonstrated that an extremely complex system, necessitating the maintenance of the most perfect synchronism, and employing as many impulses as those required for the formation of each of the letters or characters, is one practically adapted to the working of other than circuits of moderate length.

To Mr. C. L. Buckingham belongs the credit of having invented the first really rapid, long-distance, page-printing mechanism that was ever successfully employed for the transaction of ordinary telegraph business. Many years had been spent by the inventor in an endeavor to devise and perfect a printing telegraph machine that could be operated over practically unlimited distances, but it was not until the happy idea was conceived of utilizing the Wheatstone automatic system as a basis that success appeared in sight. Through the medium of the Wheatstone terminal and repeating apparatus, it at once became possible to transmit and receive the necessary signaling pulses over the longest telegraph lines, the pulses in this case differing from those of the Wheatstone or Morse in being quite definite in the number requisite to form the various character, for each of which six electrical impulses alternating in direction are essential.

The distinguishing features of the invention consist of the perforating apparatus for preparing the slip for transmission, and the printer, which is placed in a local circuit arrangement at the receiving end of the line. The operation of punching differs from that employed in the Wheatstone in that it involves the use of a typewriting machine, by means of which anyone may manufacture the slip without the slightest knowledge on the part of the manipulator as to the particular code employed, and at a rate of speed considerably greater than that possible by the use of the Wheatstone perforator.

The slip thus prepared is then run through the Wheatstone transmitter, which automatically forwards the signals to the distant terminal station where they are received upon a Wheatstone relay and thence repeated into the local-circuit arrangement. In this circuit is a variety of relays and electromagnets, which call into action a number of novel and ingenious contrivances of both a mechanical and electrical character. Under the control of the electrical impulses received over the line these devices perform their various functions with a regularity, precision and harmonious working of parts that is simply amazing.

One of these devices is a modified form of "sunflower" or current-distributing apparatus of very peculiar construction. It was especially designed to secure a rapid transmission or switching of certain line pulses through one or the other of a series of relays connected to the sunflower. Five of these relays known as "selectors" are employed for the purpose of actuating a corresponding number of electro-magnetic "adjusters," which control the movements of the type-wheel. Short pulses do not affect the selecting relays, but when the pulses are sufficiently prolonged, the motion of the sunflower or distributor—which is normally one of rotation—becomes temporarily checked or arrested by means of an electromagnetic escapement, thereby permitting any such pulse to actuate the particular relay whose circuit is at that moment completed through contact arms on the sunflower.

At least one of the series of the six line pulses required to form a character must be prolonged, and the particular relay or number of relays that shall be affected within the time required to transmit the entire series of pulses is determined by the regular order in which such pulses are transmitted to line. If, for instance, the first pulse be a prolonged one, the first in the series of relays with its corresponding "adjuster" will respond, and no other. Similarly, if the second pulse be lengthened, the second only in the group of relays will respond thereto, and so on. One or all of the

selector relays may be involved in the operation of bringing any letter or character into the required position for printing, the impression itself being invariably accomplished through the medium of the sixth pulse. This pulse, the last in the series, is always a prolonged one of a certain definite polarity, and is not only utilized for the purpose stated, but also to start the feed mechanism, as well as to operate a dogging device which holds the type-wheel firmly in position while the impression is being made. It contrives, furthermore, to actuate the synchronizer, and thereafter to reset or restore to their normal positions such of the selecting and adjusting instruments as were brought into activity by the one series of line pulses, and to thus put them in a condition of readiness for the next cycle of operations.

The type-wheel is suitably mounted upon a shaft of such construction as to permit the wheel to move axially, or circumferentially, or in both directions simultaneously. Instead of a comparatively large wheel having the entire number of characters on its periphery and rotating all the way round, the inventor employs a small wheel bearing four rings or rows of type which only rotate through a half revolution in either direction. The regulation of the type-wheel is effected through the action of the adjuster magnets whose armature levers are connected with certain impelling or driving devices, some of which impart a rotary, and others a longitudinal motion, or a combination of both movements to the type-wheel. The axial, or longitudinal movements of the wheel bring any desired ring or row of type into line with the press pad, while the rotary movements shift the different type of a row or ring into the proper position for printing.

It is by such movements either singly or in combination, that any type of the several rings may be brought to position on the completion of the requisite number of pulses.

The blanks upon which the messages are printed are the regular message forms whose edges have been pasted together so as to give the blanks a tubular shape or appearance. When the printing of a message is about to begin a tube is placed in position beneath the type-wheel by sliding it edgewise upon a brass tube which serves as a support, and in which there is an opening to admit of the necessary operations and impressions taking place. The blank when printed is quickly slipped to one side and a fresh one takes its place, after which the first blank is removed from the support by opening it on the line where its edges are joined, and so on. These latter operations are performed by hand, and they constitute about the only ones so far as the printer is concerned that are not entirely automatic in character.

The Buckingham system may well be regarded as the most unique and original one in existence, and it will deservedly take high rank among the list of marvelous and useful telegraphic inventions of the times. It has been in practical operation over the Western Union lines between New York and Chicago, and New York and Buffalo, for the past six years, and has a maximum working capacity of about 200 messages per hour operated as a duplex. It does not, as will be noticed, utilize the transmitting properties of a wire to the same extent as that theoretically possible with the Rowland multiplex system, but it is successfully operative over distances that would not at all be practicable with any synchronous multiplex system as yet invented.

The Buckingham system possesses the disadvantage of requiring a perforated strip for transmitting purposes, but, as in the case of the Rowland, the received record is a direct one instead of having to be translated as in the Murray system. If the perforated tape could be entirely abolished, and a rate of speed obtained by direct manual transmission approximately equal to that obtained in actual practice by automatic working, a grave objection to the Buckingham system would be overcome, and the author is strongly of opinion that such a change is not only desirable, but entirely feasible, and is, in point of fact, well under way.

One other defect of the Buckingham system consists in the fact that the number of characters that can be printed by means of his type-wheel is limited to thirty-two, admitting only of the letters of the alphabet and certain punctuation marks being recorded. To print all of the characters desirable for commercial telegraph purposes would involve some radical changes in the apparatus and greatly increase the already complicated character of the system. By substituting for the present recording arrangement a modified form of electrical typewriter of great sensibility and rapidity in action, a comparatively simple printing mechanism can be devised that will more fully meet the service requirements along the lines indicated, and at the same time increase the legibility, and improve the general appearance of the printed message. This is what the author has set out to accomplish, and his experiments so far demonstrate that a speed of at least 100 words per minute can be readily secured thereby. The particular changes necessary to bring this about involve the use of as many small printing magnets as are requisite for the desired number of mechanical operations. As this particular arrangement is the subject of patent proceedings, nothing can be said further than to intimate that the printing magnets are actuated by local currents properly directed through the medium of certain electromagnetic selecting devices, whose particular function is to distribute the different signaling impulses among the various printing and auxiliary magnets in a manner appropriate to the requirements in the case.

In looking over its past history, one cannot but be struck with the fact, and take pardonable pride in the knowledge, that the printing telegraph art constitutes an industry, the origin, growth and development of which may be credited almost exclusively to American inventors, whose persistent efforts in the face of many difficulties and discouragements have at last brought about an extension of its sphere of usefulness into the commercial branch of practical telegraphy. It may be reasonably assumed as a consequence thereof, that the technical and industrial development of this particular art will be much more rapid in the future than it has been in the past; but much remains to be done in the way of simplifying and more nearly perfecting the working apparatus in order to thoroughly complete the task of those early experimenters who, some fifty years ago, first undertook to solve the problem of devising a practical, useful, as well as economical, printing telegraph system.

WHO CAN ANSWER?

A writer in a Pittsburg paper, whose best girl is evidently a telephone operator, says: "Why is it that so many pertty girls drift into the telephone business? If you do not believe me, just install a private exchange, put your feet on the desk, puff your cigar and wait for them to come around. You need not advertise. They will find you out. If nine out of every ten who call on you are not just the prettiest ever, then I'll eat my hat. Of course, you'll choose the prettiest. If you need more than say three, then you will hold three queens. I speak by the card. In addition to being pretty, the average telephone girl is a fairly bright proposition. There is more human nature humming its way back and forth over the telephone wires than there is electrical current, and the telephone girl as a rule is dead next—and generally dead wise. Few of these girls grow to be old maids—don't have to, see! Lots of pretty decent fellows fall in love with the voices first and marry the girls afterward. And gold teeth! Every blessed telephone girl I know has a gold tooth. If you do not believe me, just call in your telephone girl and have her show you her teeth. Now, it's up to you."

Two Unique Inventions

RECORDS TELEPHONE CONVERSATIONS.

THERE are prospects for amusement and vexation, as well as utility, in a remarkable device for improving the telephone service which just now is attracting the attention of electricians and telephone companies. Heretofore the telephone has been deficient from a business viewpoint, in that no record has been kept of the conversations over the wire, but the new and simple device not only keeps an accurate record of all that passes through the telephone, but also repeats the words registered whenever any one cares to hear them.

The advantages of this to the business man are obvious so long as he merely transacts business over the wire, but should he talk in lighter vein in answer to a gentle voice there will be no "Central" to keep mum, but a record that will pour the whole story into a suspicious wife's ear whenever she touches the button.

After twelve years of experiment and study, Elias E. Ries, electrician and inventor, of 116 Nassau street, New York, says he has completed and patented a device by which all messages sent by telephone may be recorded on a magnetized wire and repeated at the option of the person at the receiving end of the wire. Messages, too, may be sent at night to the butcher, the grocer or the baker and piled up on his wire spool so that when he comes in the morning he will have a list of the articles which the housewives have remembered in the evening that their larders lack.

On the other hand, it will be impossible for the busy man who was to have called his wife on the telephone and made an engagement with her to go to the theater, and who forgot all about it, to tell her when he gets home that he tried to call her and no one would answer the telephone. To test his truthfulness she need only go to the instrument, turn a switch and hear whether anyone rang up the house at the hour at which he said he had called.

One other thing about Ries' system is that "Central" cannot break in to hear or interrupt a message. Her whole duty will be to give the connection desired and to break it when the signal is given that the conversation is ended, and the signal cannot be given until both persons have laid down their receivers.

Before Dr. Poulsen, the Danish inventor, took out patents on his telephone recorder several years ago Ries had developed a recording system. His appliances then were bought by Poulsen's attorneys. Now, however, he has made so many changes and improvements that he has taken out patents on them himself. There being no stylus or point which is vibrated by being dragged over minute indentations in wax, the metallic sound inseparable from the ordinary phonograph is entirely lacking in the new recorder. Then, too, since a coil of wire may be made almost endless, there is practically no limit to the length of a message or to the number that can be taken.

The wire is wrapped on different spools, which are used in order, so that any part of the record may be reached and repeated with little trouble. As applied to the stock ticker, for which Ries has made it available, too, the machine can be made to repeat the news of any earlier hour in the day at the time it is taking new messages.

"The principle is extremely simple," said Ries, "although it has not been used before in telephony. The wire, magnetized, passes under an electric pole. The voice vibrations are changed into electric vibrations as in the ordinary telephone. These passing through the electric point to the magnetized wire, leave their impression there. When the wire is run again under another electric pole the vibrations are transmitted back from the magnetized wire to the electric wire, whose vibrations in turn are transmitted to a diaphragm which sets the air vibrating exactly as it vibrated when the message was sent."

These records may be filed away and kept for an indefinite length of time, or they may be destroyed by demagnetizing the wire. It is even possible they might be produced in a divorce court if the aggrieved person in the suit could find that part of the wire which contained the tell-tale messages.

Speaking of the present telephone systems, he said that from the scientific viewpoint they were "barbarous and primitive." Not more than 25 per cent of the time spent at a telephone, he said, was used in transmitting the messages. The other was wasted by the office boy in talking to the office boy at the other end of the wire, by the girl at "Central," who was unable to always know when other persons have finished talking and so permitted the trunk lines to remain open. By his system, the taking up of the receiver signals "Central," and at the same time answers if the signal has been given to her, and the laying down of both receivers shows her immediately the lines are out of use, making it impossible for one man, by carelessness, to leave his signal light burning, as at present. Ries says by this saving of time he can give a two-cent rate in place of the present cost, and still make money.

He also has a transmitter which does not depend upon the loudness of the voice for the strength of its vibrations, but upon the electric current, which makes all parts of the message equally distinct and carries them much further than they may be sent now. His receiver is partly hollowed and contains a small quantity of mercury, which completes the electrical connection when the bulb is held in any but an upright position, and as the apparatus is counter-weighted it settles itself bottom side down and breaks the connection as soon as it is laid on the desk.

INVENTS "EARS" FOR SHIPS.

The terror in which submarine boats have hitherto been held by ocean vessels in time of war promises to be entirely dissipated by the appearance of a simple apparatus, which the inventor, J. B. Miller of Boston, Massachusetts, calls "ship's ears." With this new device, secret submarine attack is, the inventor claims, made impossible, and all the former disadvantages of the bell buoy and the lighthouse, particularly caused by a heavy fog, are done away with, for the new "ears" catch sounds under the water and locate exactly the point of the compass from which they come.

The invention has been installed on steamers of the Metropolitan Steamship Company, and for four or five weeks these vessels have been using the apparatus constantly for the purpose of testing its accuracy under all conditions. The captains of the steamers have reported to the officers of their company that they have been able, invariably, to locate at three miles' distance the Boston light-ship, upon which a submerged bell was being rung, when the vessels were approaching at full speed.

The receiving apparatus of this unique submarine telephone has two receivers, one for each of the vessels. These are inclosed in iron cases, screwed into the hull of the vessel below the water line. A connection is made by wire between the hull and the wheelhouse where the telephone box is placed. By moving a switch to right or left and then holding the earpieces to his ears, the listener can ascertain whether or not there is any danger or warning of danger ahead.

and where it is located. This method is so accurate that the steamers using the system have often found their direction within one point, and by a little maneuvering of the vessel a captain can always get his direction with accuracy.

The vibrations which he hears are initiated by the bell hung over the side of the lightship or suspended in the water at the end of a cable from a lighthouse or bell buoy. The bells are struck by a hammer exactly like a bell in the air, only with more force. These vibrations are taken up by the receiver on the sides of the vessel and transmitted through the telephone.

A type of apparatus designed for fishing boats or small vessels of any kind includes a receiving box, with a ball receiver, which is lowered into the water. It is obvious that some sounds would be too delicate to penetrate the side of a vessel. To meet this case, a receiver has been invented which is lowered directly into the water and picks up sounds of comparatively small intensity. Where a vessel is not supplied with receivers on her own hull, by lowering a ball receiver first on one side of the vessel and then on the other and noting the difference in the intensity of the sound it is possible to discover the course of the signal, whether it be the signal of a fisherman in a dory, bell buoy or another vessel.

To appreciate the importance of this invention to the maritime world it is only necessary to consider that at the present moment there are no sound signals in the air which can be trusted. Sea captains testify that they have sometimes been unable to hear a fog whistle when within half a mile of the whistle, although they could hear it plainly several miles beyond that point. In other words, there are zones of silence even in pleasant weather. The water, however, is always of the same density, and sound in the water travels with the same speed, whatever the weather conditions. It follows, therefore, that signals sent through the water can always be depended upon.

The receiving apparatus is so delicate that it picks up sounds of small intensity. If it is possible to ascertain that a submarine boat is approaching a cruiser, half the terrors of this weapon of warfare disappear. It would be possible, also, for naval vessels under fire to signal to each other through the water, using such a code as may be determined upon.

MUNICIPAL TELEPHONES.

Great Britain is taking the lead in the municipal operation of public services, and the telephone is likely to pass under control of the civic authorities. At the present time municipal exchanges are in operation or in course of construction in Glasgow, Brighton, Portsmouth, Swansea and Hull, and the results have been generally satisfactory. In Glasgow there is now a service of 11,500 telephones, with an average revenue of $21 each. Out of this average charge there is a royalty of ten per cent paid to the postoffice department, and the net return is sufficient to provide for interest and sinking fund and set aside a surplus for depreciation.

These results have been obtained from two years' operations. The service covers an area of 143 square miles, and the equipment is far superior to that in use where the telephone is a monopoly held by a private corporation. The Brighton municipal service has recently been introduced and has nearly 1,000 subscribers. The whole of the plant within the town is underground, poles being used only for country service. The town has the disadvantage of a competitive service by a private corporation, but the opinion of the subscribers is said to be strongly in favor of municipal control.

In Portsmouth the municipal system was established in March, 1903, but the operations have already resulted in a surplus. The rate is $28.61 for an unlimited service. The average receipts for the past year were $17.54, which produced a gross revenue of $29,137. After paying all fixed charges, operating expenses, postoffice royalty and government long-distance charges, there was a surplus of $11,095, or over nine per cent on the capital expenditure. At Swansea the system has not been in operation for a year, but it has 750 subscribers, with almost enough additional orders to bring the list up to one thousand. A revenue of $19.50 per telephone has been found sufficient to pay all charges, meet all expenditures and leave a substantial surplus. In Hull the municipal exchange will soon be in operation, with over one thousand subscribers. The rate will be $30.68 for an unlimited service, $28 for second and subsequent connections, and $14.61 for measured service, with two cents for each outgoing call. It seems to be the general opinion in Great Britain that municipal telephony has come to stay.

THE TELEPHONE APPRECIATED.

As an example of the density of telephone installations among householders as well as business establishments, the secretary of a neighborhood club of thirty-five members, at Lynn, Massachusetts, recently received information over the telephone announcing the sudden death of one of their number, and this required that information of the postponement of a meeting of the club appointed for the next evening should be at once promulgated to the members.

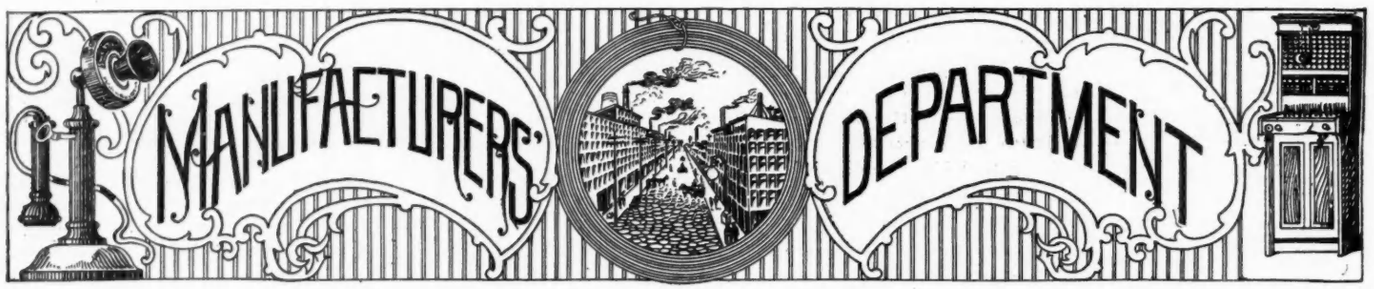
On consulting the telephone directory, it was found that twenty-eight of the thirty-five members were provided with telephones at their homes, and the remainder had them at their places of business, and all of those who were in business at Lynn or Boston had telephones at their offices. That is, among the thirty-five members, there were twenty-eight residential telephone and thirty-two business telephones, making sixty telephones at the service of these thirty-five persons, eight of whom had private branch exchanges at their places of business.

In the evening, the secretary communicated to the twenty-eight residences the information of the death, and gave notice of the postponement of the meeting, also answering numerous questions which the notice evoked, making in all thirty-two calls; as four of the lines were reported busy, second calls were made later, and these persons were notified during the short space of thirty minutes.

All except four of the 103 members of a golf club at Chestnut Hill can be reached by telephone; seventy-eight having telephones at their residences, and eighty-three at their places of business, making a total of 161 telephones for these 103 people. As nine of these members are single women, students or retired, so that they have no business, the relative business density of telephone installations is eighty-three out of a possible ninety-four.

As the telephone began as a business luxury, available only to those of large commercial affairs, says a leading electrical paper, its later development has extended to residences, smaller stores, and to isolated houses in sparsely settled districts, particularly the homes of farmers, being especially useful to them, while it will still continue to ameliorate the condition of the rich. Is it not evident that the excellence of this telephone service was a prominent factor in securing the large number of subscribers which this occurrence indicates?

That telephones at street corners, either on the telephone pole or on the same post with the mail box, may be a future convenience of many cities and towns is asserted. Already they are in use to a limited extent, keyless stations opened by merely turning the handle and which contain the pay station and a directory being the equipment. Hollow iron posts allow the necessary ground wires.



KUSEL & KUSEL COMPANY.

The latest firm to enter the wide and ever-growing Independent field and make a strong bid for trade is the Kusel & Kusel Switchboard and Telephone Manufacturing Company, which has opened up an elaborate suite of offices and salesrooms in the Monadnock building, Chicago, corner Dearborn and Van Buren streets. The members of this new organization are Messrs. I. J. and H. J. Kusel, who are well and favorably known in the Independent field and who have an acquaintance among telephone men that extends from coast to coast. Their large knowledge of the telephone business in all its varied phases is admitted by all who know them or have had dealings with them in the past, and they bring into their newest business venture a ripe experience, which is sure to stand them in good stead in winning trade, and in carrying on to a highly successful outcome the undertaking they have just launched and which is receiving merited recognition far and near.

I. J. KUSEL.

H. J. KUSEL.

Kusel & Kusel being the first concern to offer for sale both automatic and manual telephone equipment claim—and consistantly, too—that their line of apparatus embraces the most complete equipment ever placed on the market by any company. They recognize that there is a field for both, and that each has its advantages as applied to its respective uses. Their systems are also arranged to work inter-connectingly, so that if a purchaser desires to place at the main exchange a manual system, and in the outlying branch exchanges automatic, to give increased earnings and revenue, they are prepared to furnish such a system.

In addition to furnishing complete apparatus of both kinds the company will make a specialty of manufacturing parts of magneto generators for both alternating and pulsating currents, receivers, transmitters, switchhooks, switchboard parts, and will name advantageous prices to any company interested in purchasing such apparatus in large quantities.

The Kusel & Kusel company is operating under a number of valuable patents, and wishes to add that all of its apparatus is placed upon the market under a broad and strict guarantee. Included in its line, in addition to its automatic apparatus, is its self-restoring target magneto drop switchboard, as well as its lamp line and target central energy switchboard.

This company is placing on the market in its "Ring-Thru" telephones what it terms its K.-K. magnetic "ring-thru" coil. This is a special device to obviate the use of condensers, choke coils, carbon resistance coils, and non-inductive wound coils, for the purpose of enabling the subscriber's line and bridged or party line to "ring-thru" with the receivers off the hooks. The Kusel & Kusel Company claims superior features for this coil, without any additional complication of apparatus in the circuit, and greater talking power in the microphone circuit as well. The company is furnishing these improvements in their telephones regularly or will furnish them separately to companies that wish to install them in their telephones, which will enable them to "ring-thru" with the receivers off the hooks.

This invention is of great value to the Kusel & Kusel Company, and while it was the intention of the company at first to employ this only in connection with their own instruments, they have concluded to sell to the general trade. It takes the place of the regular induction coil customarily employed and makes the same connection, but accomplishes the results obtained from the employment of condensers without the use of such additional apparatus in the circuit. The company will be pleased to give full information regarding the K.-K. magnetic "ring-thru" coil to any one interested.

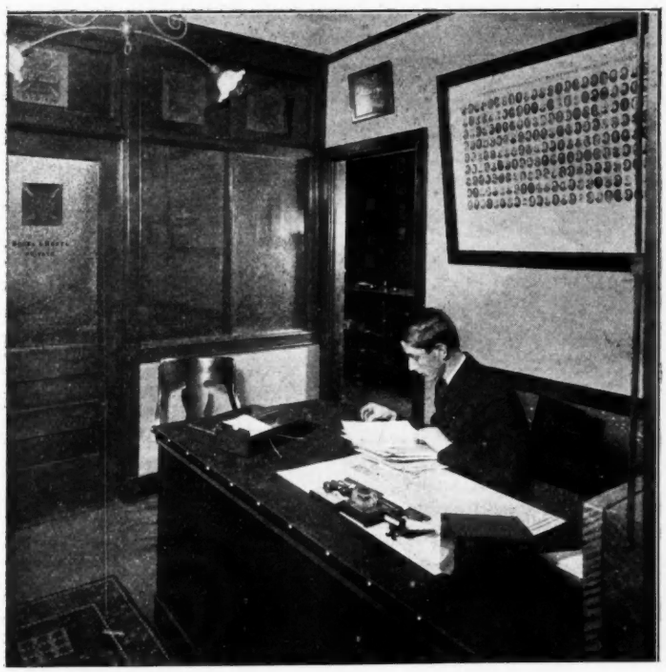
The Kusel & Kusel Company reports that its Clark auto-

matic telephones system is the only automatic telephone system employing only one relay in the entire circuit, and for branch exchange work is not surpassed for simplicity and absolute reliability. Endorsements on this apparatus are of the very highest. The company would be pleased

PRIVATE OFFICES, KUSEL & KUSEL COMPANY.

to send testimonials and descriptive matter describing system to any companies interested.

The company is issuing the following bulletins, embracing its line of telephone apparatus, which they will be



RECEPTION ROOM, KUSEL & KUSEL COMPANY.

pleased to send to any person or company interested, upon request: Bulletins A and B are on automatic apparatus; C is on central energy switchboard apparatus; D and E on manual magneto switchboard apparatus; F on switchboard parts; G on compact bridging telephones; H on bridging telephones; I on selective signaling apparatus and telephones and one-way ringing telephones; J on branch exchange switchboards; K on lightning arresters and protector apparatus; L on construction material and supplies.

The company also is placing upon the market and introduces to the trade its Eagle dry battery, which for telephone work, on short circuits, gives out from fifteen to twenty amperes and is guaranteed in the matter of extreme long life and highest efficiency. By specifying that tele-

DISPLAY ROOM, KUSEL & KUSEL COMPANY.

GENERAL OFFICES, KUSEL & KUSEL COMPANY.

phones shall be equipped with the Eagle guaranteed dry cell battery the Kusel & Kusel Company promises that customers will secure the best.

The company can insure prompt shipment, as its line of apparatus is complete, and special efforts will be made by

the firm in seeing that its customers secure prompt delivery at all times. Any inquiries addressed to the Kusel & Kusel Company, Monadnock block, Chicago, will receive courteous and immediate attention.

As a special inducement to place on their books the names of as many new customers as quickly as they possibly can, they offer to send, with their compliments, a beautiful "Auto Clock," encased in a handsome morocco case, to each customer sending them his initial order. Kusel & Kusel will be pleased to have their friends and patrons visit them any time they are in Chicago. Views of the general offices and salesrooms of the company are herewith shown.

GEMMILL TELEPHONE COMPANY.

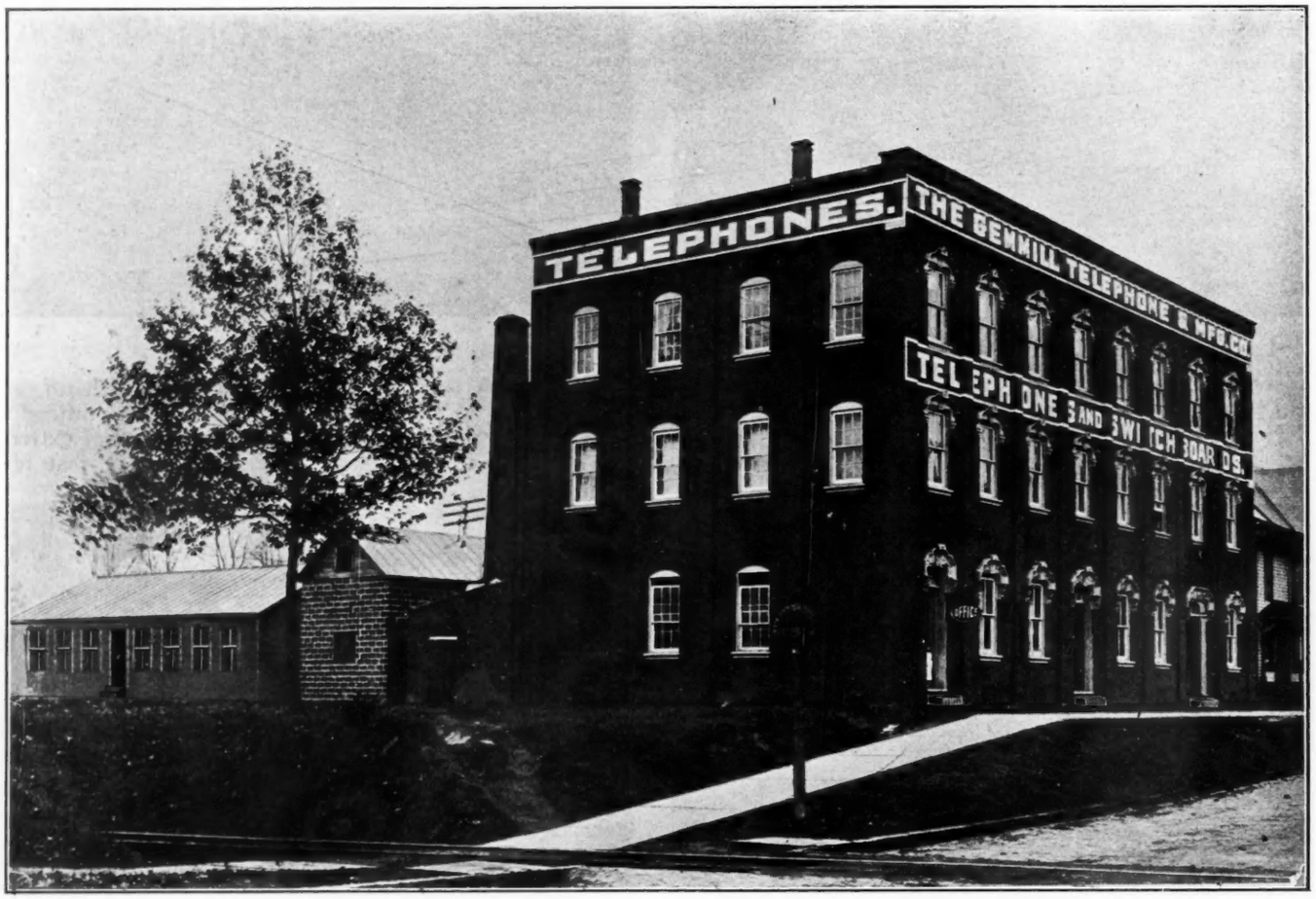
One of the most important recent additions to the Independent telephone field is represented in the new and commodious telephone manufacturing plant of the Gemmill Telephone & Manufacturing Company at Orrville, Ohio, equipped with the latest improved machinery and with facilities unexcelled for handling a large volume of business. The power plant consists of a 150 h. p. Buckeye engine, boiler, and with 75 k. w. generator of the latest Northern Electric Company's design, all machinery being electrically driven from separate motor on each floor of the various departments. Lathes with automatic attachments, milling machines, punch presses for heavy and light work, multiple spindle drills, automatic screw machines, improved hot blast furnaces, foundry and magnet room have been installed.

The main building is three stories in height; boiler house, engine room and furnace house are of brick and aggregate a floor space of 50,000 square feet. The factory is favorably located in the downtown district at the juncture of South Main street (one of the most highly improved and attractive thoroughfares) and the Wabash railway.

A complete line of magneto telephones, switchboards and central energy telephones will be manufactured under patents owned and controlled by the new company. The special feature of improvement in long-distance inter-state transmitters, loud speaking receivers, powerful generators and the ball express switchboard are of much interest to operators of large exchange and trunk line systems.

The many orders already received and filled by this new concern demonstrates the great necessity for a thoroughly high-grade apparatus, which can be adopted as a standard for use under the most severe and exacting conditions.

The company is ably represented by leading business men, bankers and telephone experts, the officers and management comprising: J. E. Gemmill, president; A. J. Heller, vice-president; D. J. Leickheim, secretary and treasurer; Charles E. Taylor, superintendent; J. R. Gemmill, electrical engineer. New illustrated catalogue will be sent upon application.



FACTORY OF THE GEMMILL TELEPHONE AND MANUFACTURING COMPANY.

A NEW SUBSTITUTE FOR RUBBER.

The Insulatus Rubber and Manufacturing Company was incorporated in Chicago in the month of December, with a capital stock of $1,500, having its general offices in the Rialto building, on Van Buren street. This new concern proposes to open, within the next sixty days, a large factory for the manufacture of a rubber imitation, both in soft and hard forms. The material is said to be composed of a vegetable and mineral combination, of which the in-

gredients and process are secret, and known only to the discoverer, Gray Staunton of Chicago. He has associated with him George H. Phillips, widely known as the "Corn King," and a number of other prominent Chicago gentlemen. It is claimed for their preparation that its cost will be but about one-fifteenth that of crude rubber, while its insulating properties are greatly superior. They propose to manufacture insulating materials of all kinds for the electrical and telephone trade.

DEAN METAL BOX TELEPHONE.

The accompanying illustrations show the new Dean metal box common battery telephone designed for business, residence or hotel use. It is without doubt one of the most compact commercial telephones ever designed, and is fitted with full sized standard apparatus and with standard circuits. In fact the apparatus and circuits are the same as for the regular Dean wall telephone, and, being complete, will gave the same high efficiency for long-distance service.

The use of standard parts does away with the necessity of carrying a special stock of apparatus for repairs; in fact, full size apparatus is not so conducive to troubles as parts which are cramped in design to obtain compactness. The case of this telephone is made entirely of thick sheet steel, polished and finished with a tough black enamel. The base and cover are each drawn from one piece of metal without seams, thereby making the complete telephone very rigid and substantial. The cover is hinged to the base and locked by a spring catch. When the telephone is open it exposes all of the working parts for full inspection.

A compact adjustable transmitter arm, made from drawn

COMMON BATTERY TELEPHONE NO. 30.

metal parts, is provided. It is held in its various positions by an adjustable spring which will not work loose—a simple accomplishment, but one that has heretofore caused manufacturers much trouble.

The ringer tapper is protected from mechanical injury by a special guard, while the hook lever is removable, same as in other Dean telephones, to prevent damage in packing, shipping and handling. This removable lever type hook-switch is entirely original with the Dean Electric Company, and is a feature which has caused much favorable comment wherever it has been shown. The removing and the replacing of the lever does not require tools, neither does it disturb the switch mechanism, which is actuated by a stub lever. The latter serves as a lock to hold the lever securely in place, and partakes of its motions when the hook is operated. It is thus absolutely impossible to remove the projecting lever when the telephone cabinet or box is closed. All Dean wall type telephones are provided with these new hook-switches.

The internal wiring of this metal box telephone is done with a special insulated copper wire sewed into a cable similar to that used in large switchboards. The outer insulation of the wire has distinguishing colors so that the circuit between the different pieces of apparatus can be easily followed. This is surely a great improvement over the existing methods of wiring telephones.

The extreme simplicity of the new Dean common battery circuit, which uses a balanced bridge coil of Wheat-

COMMON BATTERY TELEPHONE NO. 32.

stone's type to prevent the direct line current from flowing through the receiver and damaging the same, renders the electrical equipment of this telephone simplicity itself. The two terminals of this coil are connected to the transmitter and to the hook-switch respectively, and these in turn to the line binding posts. The receiver is connected directly to the coil by means of binding posts located in the spool-heads, thereby effectually doing away with unnecessary wiring. It will be noticed that this arrangement requires only a one-contact hook-switch and eliminates the condenser entirely from the talking circuit. The chances for trouble are thus not only reduced to a minimum, but the absence of complicating apparatus in the talking circuit allows the voice currents to act practically unimpared and direct. The available transmission is thereby given a chance to produce its maximum effect and the best possible results obtained for long-distance service.

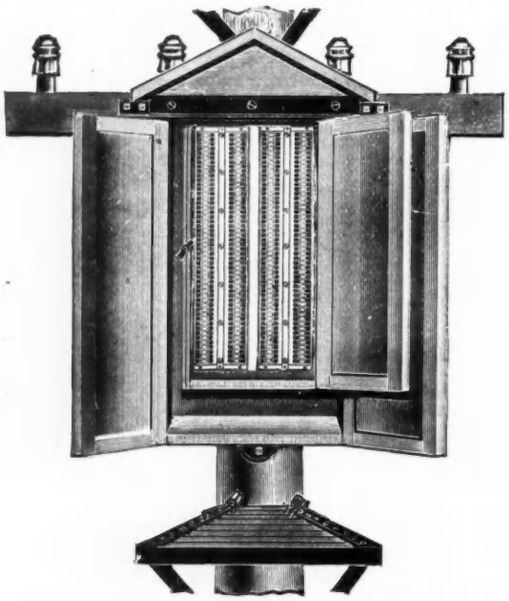
All of the parts entering into the circuit are thoroughly insulated from the external metal of the case and exposed apparatus, so that it is impossible for the subscriber to obtain a shock while using the telephone.

A detachable metal writing shelf has been designed for this telephone so as to adapt it for business use. A roll of note paper is mounted in a compartment so that it can be drawn down over the writing surface for making notes while using the telephone. This paper can be torn off as desired by the aid of a simple attachment.

The Dean Electric Company also makes a complete line of standard size telephones for both local and common battery service. All of these telephones are fitted with the new Dean long-distance transmitters and receivers and are otherwise designed for the most exacting requirements of exchange or private line service. This apparatus is fully described and illustrated in the Dean company's little booklet, No. 2, which will be gladly furnished upon request.

SECURITY CABLE POLE HOUSE NO. 1.

The average carpenter can make just as good a house as the one shown in the accompanying illustration if he is smart enough and has the tools, but he generally does not know how nor what is needed, and in no case can he compete with the machinery which the E. Bissell Company of Toledo, Ohio, has for this particular purpose. These pole houses are made in cabinet style, and equal quality cannot



SECURITY CABLE POLE HOUSE NO. 1.

be produced by hand at the same prices. The Bissell company has made them for seven years, reducing prices as trade increased.

These houses are dry. There are two compartments, both provided with doors, all doors closing against shoulders, and no communication is possible with the outside except through the bottom, where the cable and spider wires enter, and where joints can be and usually are made water tight. They are suspended from iron straps which encircle them and are held by screws run into solid wood, and in no case entering the inside space. At the bottom is an adjustable shoe, through which the cable passes. The shoe is lagged firmly to the pole, the house is then set perpendicularly and permanently bolted in place. Eight sizes are made. Used in connection with these pole houses are the security distributing panels.

CHICAGO NON-SHUNT INDUCTION COIL.

Users of bridging telephones will be interested in the non-shunt induction coil, which does not permit a line to be short-circuited when the receiver is removed from the hook. This non-shunt induction coil, it is claimed, absolutely does away with the loss of efficiency in the ringing circuit of a bridging line, caused by "rubbernecks." The patents under which this coil is made are controlled by the Chicago Telephone Supply Company of Elkhart, Indiana, which invite correspondence respecting same.

As an example of what this coil will accomplish, it is claimed that when twenty bridging telephones, more or less, equipped with the Chicago non-shunt induction coil, are placed on one line, and all the receivers but two, or more, are removed from their hooks, under such circumstances the remaining telephones will ring each other just as loudly and clearly as though there were no other telephones on the line. This coil does not permit a bridging line to be short-circuited when the receiver is off the hook.

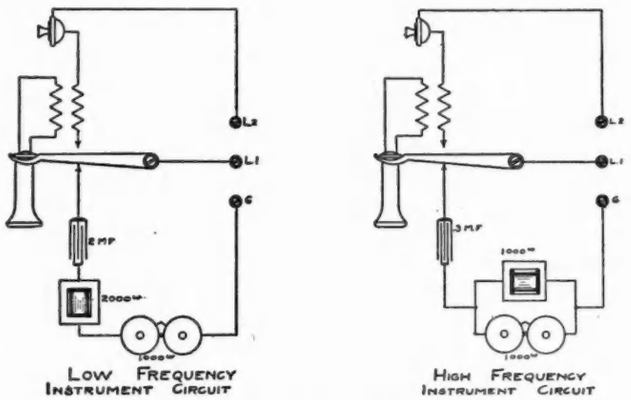
The Chicago non-shunt induction coil can be attached to telephones now in use. Samples will be sent to any address for 75 cents each.

For further particulars, address Chicago Telephone Supply Company, Elkhart, Indiana.

SELECTIVE SIGNALING SYSTEM.

Among recent installations made by the American Electric Telephone Company, Chicago, are two which are of exceptional importance to the Independent field. The first of these was at Fort Worth, Texas, and the second at Kewanee, Illinois. At Kewanee a central energy lamp line switchboard of 640 capacity is giving service to an exchange of over 1,500 subscribers, as good service as is given anywhere. The reason for this low switchboard capacity is due to the use of the well-known Leich four-party selective signaling system, of which the American Electric Telephone Company is sole manufacturer. The use of this system has made it possible to build this exchange with less than one-half as many subscribers' lines as would be necessary if only single line telephones were used. It is becoming more and more apparent every day that it is impossible to adequately serve a community with telephone service unless selective telephones are used.

Of course it has only been possible within the last few years to give good four-party service. The invention of the Leich four-party selective system has given to the Independent operators a system in which troubles are prac-



CENTRAL ENERGY SELECTIVE TELEPHONES.

tically unknown. There are no adjustable features in the instruments, as is explained in the new bulletin No. 25, issued by the American Electric Telephone Company. The circuit of these instruments for central energy is shown herewith. From this circuit it will be apparent that no springs are necessary to cause the bells to operate selectively. An impedance coil, together with the condenser, is used for this purpose. Condensers are in series with the bells so that no battery leakage is occasioned. The ringing voltage at no time exceeds 90, and thus the use of this system will not endanger the cables or switchboard parts. The Leich system has now been in use a number of years in some of the largest exchanges in the country and has given ample demonstrations of its success.

MOON JUNCTION BOX.

The Moon Manufacturing Company, Chicago, manufacturers of terminal heads, is manufacturing a junction box for both underground and aerial telephone cable, which affords ample room for splicing the cable wires in such a convenient manner that expert labor is not required. It is

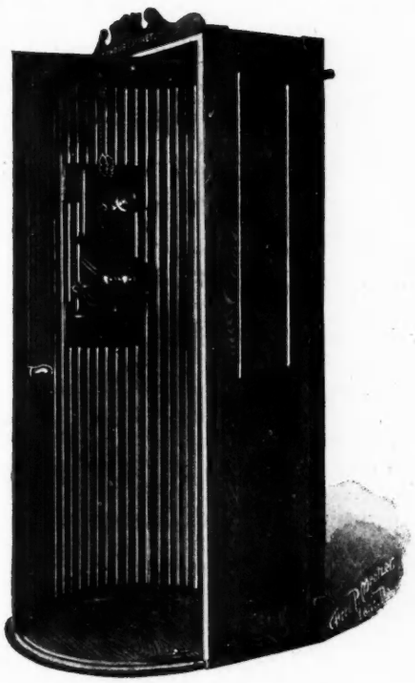
equipped with two, three, or four Moon self-soldering nozzles, for cables of any size.

Although the box is absolutely moisture proof, it is so constructed that it may be partly filled with paraffine or compound and still afford a convenient place where the cable wires may be tested without destroying or cutting into a joint. The joint which is formed is the strongest one it is possible to construct, cannot be "broken off," and is free from the danger of "blow holes."

The Moon junction box makes quick work and simple work of cable splicing. It is a great acquisition in cable construction and the company claims it will largely supersede sleeve splices.

FOLDING TELEPHONE CABINET.

Greater privacy is one of the necessities accompanying the increased use of the telephone, and looking to the accomplishment of this end the telephone cabinet has been worked out with much ingenuity. Some of the earlier cabinets were quite ponderous and massive affairs, something like a stateroom, with equal capacity in the direction of stuffiness; but the later developments in the line of



FOLDING TELEPHONE CABINET.

economy of space, privacy, ventilation and other essential features may be judged from the interesting illustration here shown. This cabinet occupies about one-third the space of the regular standard booth. It is a handsome piece of furniture, being constructed entirely of hard wood, finely finished. The telephone wires enter through the pivotal center in the top, and are carried to the wall telephone, which is attached to the rolling section, or in case a desk telephone is in use, a shelf is placed conveniently arranged for holding it.

The cabinet is sent out completely finished, and can be set up by anyone, as only a few screws are required to attach it firmly to the wall. As will be observed, the cabinet is based virtually on the idea of the roll top desk, so that it is like Oliver Goldsmith's bed, "contrived a double debt to pay," serving alike as an open or a closed booth. The cabinet projects only 17 inches from the wall, it has no door opening inward or outward, and has a clear space inside of 30x32 inches. There is plate glass 36x7 inches in both the sides, providing ample light. The bottom is hinged at the semi-circle for convenience in crating and carrying through narrow halls and doorways. When closed for use the cabinet occupies only 35x35 inches of floor space. It is known as the "Perfected Attick" and is manufactured under patents by the Folding Cabinet Company of Lancaster, Pennsylvania.

Catalogue and further information will be sent upon application.

MORRIS HARD FIBRE CLEATS.

The Morris Electric Company of Wilmington, Delaware, is manufacturing a specialty, which has found great favor among telephone managers and for which there is a constant and growing demand—the Morris hard fibre cleat,

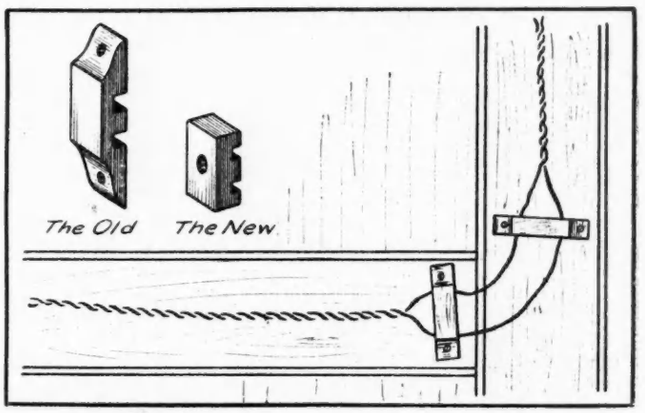


FIG. 1.

designed to take the place of the clumsy and unsatisfactory porcelain and wooden cleats. That it is fulfilling its mission in a highly satisfactory manner is proven by the large sales which the Morris company is making of this cleat and by the many re-orders it is receiving.

These fibre cleats possess many advantages. They are neat, durable, easy to install, good insulators, and on account of the finished appearance they make, are just the thing for office or residence installation. They are very much smaller than either wooden or porcelain cleats, which fact alone enables an ordinary installer to make a practically concealed job of wiring. The cleats being made of fibre

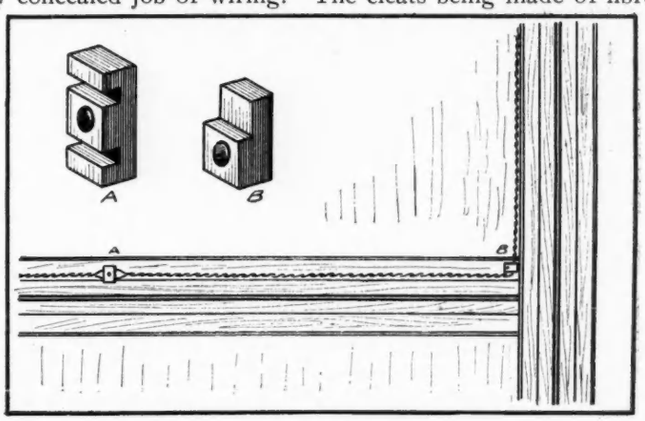


FIG. 2.

are, of course, perfect insulators, and they will never break. This latter point will appeal to all managers who realize the necessity of economy. The prices for these cleats are no more than for ordinary porcelain and cheaper than wooden cleats.

They were originally designed for telephone wiring only, but are now being used all over the country for bell wiring, annunicator systems, time clocks, telegraph outfits, etc.

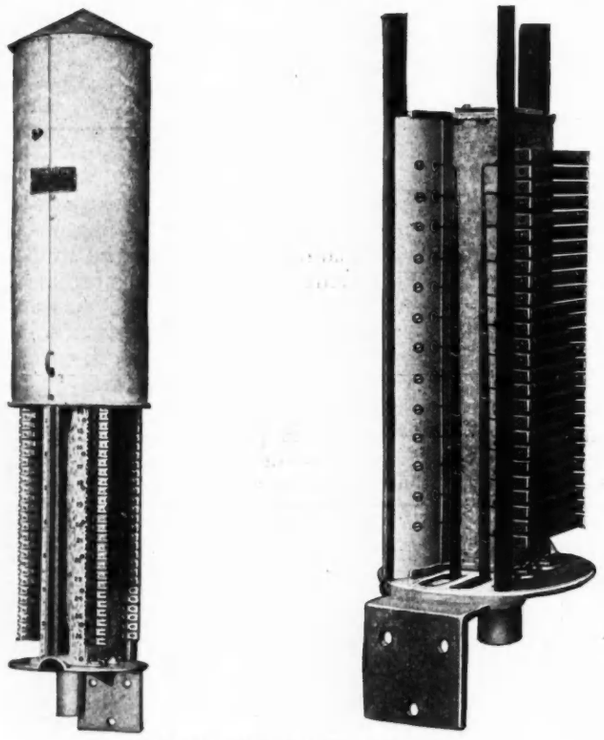
Also by gasoline engine, automobile and storage battery manufacturers for fastening wires to metal or slate. They are made in three colors, red, gray and black, to harmonize with different styles of woodwork and interiors. Several styles are made—for corners, two wires, twisted pairs and three wires.

In Figs. 1 and 2, respectively, are shown drawings of inside wiring run with the old wooden or porcelain cleats, and the new hard fibre cleat. Samples and particulars may be had by addressing the Morris Electric Company, Wilmington, Delaware.

COOK POLE CABLE TERMINALS.

Frank B. Cook of 242 West Lake street, Chicago, has been making some radical improvements in his pole cable terminals, and states that he has at last evolved what he considers the best cable protection on the market. His type S. A. terminal is a combination of the tubular line fuse and carbon lightning arrester mounted upon a galvanized sheet steel cable box. This is provided with a bracket so that the terminal can be attached either to the cable pole or cross-arm. A sliding galvanized cover thoroughly protects all connections from the weather.

Cook made these terminals, for some time using a heavy cast iron cable box, but the sheet metal box which is at

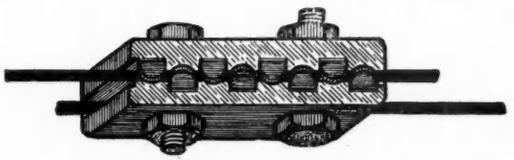


COOK POLE CABLE TERMINALS.

present used in the construction of the terminal reduces the weight considerably and makes the connections easier of access. The illustrations herewith give a very good idea of the terminal. Two views are shown, one being a front view with the cover raised and several line fuses removed, showing the construction of the mounting springs. The type T. A. terminal, which is for use exclusively with pot-heads, is the same in size and exterior appearance as the type S. A. There is a difference in the mounting, however, as hard maple strips are used in place of the sheet steel cable box, the tubular fuses and carbon lightning arresters being mounted on these strips. The strips are rigidly attached to the bracket. With either of these terminals it is unnecessary to use the old-time pole-house or balcony. The galvanized metal cover stays up when it is raised—locked there automatically—and when it is pulled down it also locks automatically.

Cook claims that these terminals are absolutely weather-proof, and that they combine ease of access with efficiency and simplicity. Being constructed of metal, they cannot burn up, a common fault of the old wooden pole-house.

The springs which hold the tubular fuses are so arranged that it is impossible for a man to leave a loose connection.



Type OO, Cook 2 Bolt Multiple Contact Line Test Connector.

The terminals will go where a pole-house would not—between the wires if desired—and it is unnecessary to move the wires or the guys. Mr. Cook has submitted these terminals to a great many telephone engineers, and has had some exceedingly favorable opinions on them. Mr. Cook's twenty-five years of experience in the engineering field also gives some weight to his opinion.

One of the specialties which Frank B. Cook has been making and selling in large quantities is his type "O. O." multiple contact test connector. This connector is made on the same principle as Cook's well-known Universal guy clamp, and it has found favor with the telephone companies, both on account of the fact that it insures perfect contact and also because it is adjustable to different sizes of wire. Cook has just received an order for 3,000 of these connectors from one company.

TELEPHONE HYGIENIC GUARD.

The ever increasing crowding together of humanity, the rush of business methods and the eager adoption of whatever aids in "quick work" is constantly bringing people into closer contact. Were it not for the fact that the invention of sanitary appliances and methods keeps pace with this, the world would doubtless be constantly ravaged by contagious and infectious diseases. Municipalities are bending their best energies to this problem, and the sanitation of modern cities, teeming with human beings healthy and diseased, herded together in close contact, is probably the most important and serious problem they have to deal with. This condition of things has put a premium upon the efforts of those who make a study of antiseptic and hygienic devices.

One of the most ingenious, as well as simple and effective, contrivances we have seen in this line is a device for obviating the collection of disease germs in the mouthpieces of telephones and of enabling the user to bring his lips into proximity with an entirely clean surface, instead of one contaminated by the breath of other users. Such a device undoubtedly fills an important purpose. A person afflicted with a germ disease, or whose breath is fevered, will necessarily leave the mouthpiece of a telephone he has used infected with the germs of disease. These deposited with the moisture of the breath become, when the moisture has evaporated, ready to be inhaled into the lungs of the next user—as sure a method of innoculation as could be devised. The device in question consists of a roll of paper, antiseptic and chemically pure, which passes in front of the mouthpiece of the telephone, so arranged that by the turning of a knob a constantly changing and ever clean surface is presented for use. It fits closely over the mouthpiece, preventing the admission of dust and keeping the mouthpiece in order. It does not impede the transmission of sound, but rather magnifies it.

The importance of some device to protect users of telephones from the dirt, as well as the germs of disease which

accumulate in the mouthpieces of telephones, has long been recognized, and several appliances have been tried, but at best, they were ineffective and only palliative. Some were only accumulators of disease germs and others (to be applied at the time of using the telephone) were only of occasional use. The advantages of the appliance presented by the Telephone Hygienic Company of Los Angeles, California, will be seen.

First—It very materially magnifies the sound of the voice and gives a more distinct message both to receiver and sender.

Second—The mouthpiece is kept clean by the paper drawn tightly over the top, the person using is always talking against a sheet of paper, not only perfectly pure and clean, but rendered germ proof by antiseptic treatment and being tightly rolled is not exposed even to any slight impurities which might be in the room until ready for use.

The following extracts are taken from an editorial in the San Francisco *Argonaut* of a recent date: "Dr. Vincent P. Buckley of the San Francisco board of health declares that the germs of tuberculosis are harbored in the transmitters of the telephone. The other members of the board agree with him and say that the use of public telephones by hundreds of people leaves in the transmitters the germs of many

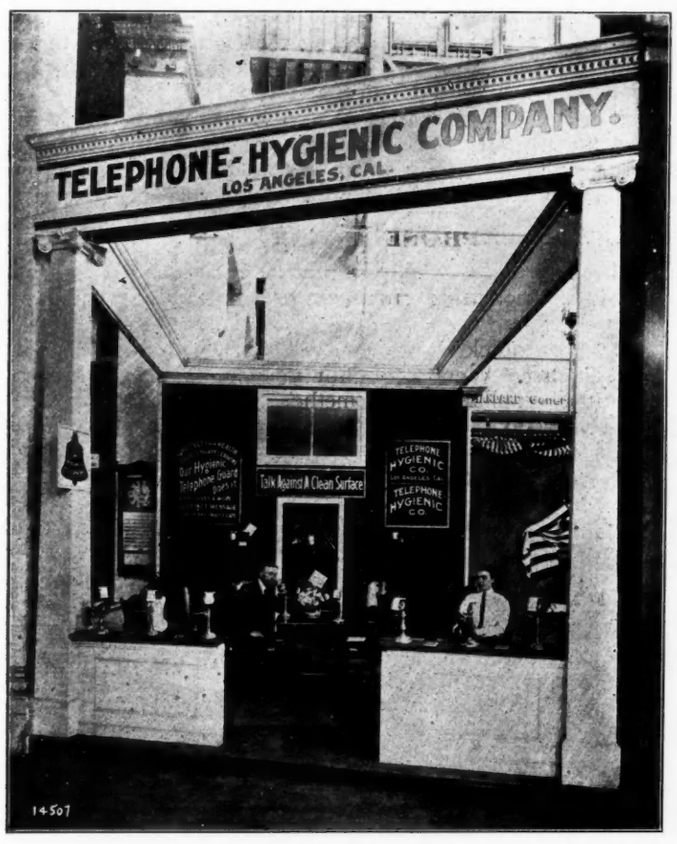
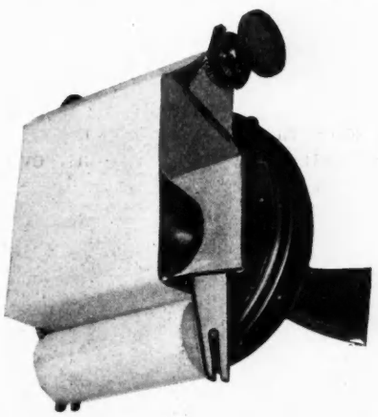


EXHIBIT AT WORLD'S FAIR, ST. LOUIS.

dangerous diseases. Health Officer O'Brien agrees with Dr. Buckley that the telephone transmitter is a grave danger to health. Clean people strongly object to using drinking vessels, tooth brushes and other utensils that have been applied to other people's mouths. They are wise. There are many dirty people in the world and many of the dirty people are diseased. We see no reason why the clean people should kiss the dirty ones. There are equally strong reasons why they should not insert their lips in telephone transmitters used by dirty people. Tuberculosis is only one of the many maladies communicated by way of mouth. The most vile and loathsome disease known to mankind finds a fertile lodgment in the human mouth. We advise all clean people who do not like to use their neighbors' tooth brush to stop using public telephones."

While the vigorous advice quoted above refers particularly to telephones in public places to which *everyone* has access, the transmitter in your home or private office needs the same protection. The danger arising from the germs of disease is not confined to those whose external appearance is dirty and repulsive. The neighbors who borrow the use of your telephone may easily leave in your mouthpiece the



TELEPHONE HYGIENIC COMPANY'S SANITARY DEVICE.

bacilli of pulmonary disease without perhaps even knowing it themselves.

Intelligent people everywhere will agree with the *Argonaut* in the opinion that there is danger lurking in the open telephone transmitter. The microscope reveals various kinds of disease germs and it is possible to contract consumption, catarrh, scarlet fever, diphtheria, and even cancer or worse diseases, in this way. In using the patented attachment of the Telephone Hygienic Company on the mouthpiece of the telephone a safe, clean and dainty instrument is provided, which not only insures against disease, but enables one to talk in a lower voice, as the paper enhances the vibratory power of the telephone.

Dr. Vincent H. Buckley and W. B. Lewitt, members of the San Francisco board of health, were appointed a committee to examine models of sanitary appliances for attachment to mouthpieces of telephones and reported as follows:

> There is one appliance that your committee considered superior to all others submitted in that a clean surface is presented to the lips and nostrils of each person using the telephone. This is not accomplished by interfering in the slightest with the transmission of the message, but on the contrary there is apparently an improvement in the conveyance of sound by those telephones to which those appliances are attached. This instrument is called the Telephone Hygienic Appliance and consists simply in an aluminum frame work supporting a roll of white paper. The paper is passed across the mouthpiece, fitting snugly thereon, and thereby preventing any accumulation of foreign matter within the transmitter. In use the lower end of the paper is gently pulled and a clean surface is unrolled, and the piece that has already done service is removed by simply pulling against the lower edge of the frame work which acts as a paper cutter. In communicating with the manager's office of the telephone company in regard to sanitary appliances for telephone mouthpieces, the assurance was given that all such appliances that had been submitted for examination at that office were objectionable, except the one submitted by H. L. Cutter, called the Telephone Hygienic Appliance.

At the St. Louis World's Fair the Telephone Hygienic Company had an attractive exhibit and received the highest award in its class. An illustration of the booth and exhibit of the company is presented herewith.

The invention fills a useful sphere in the field of hygienics and sanitation, and we see no reason why, as it becomes generally known, it should not be received into universal favor.

NEW IDEAS IN MEASURED SERVICE.

In room 1061 of the Monadnock block, Chicago, corner of Dearborn and Van Buren streets, the Controller Company of America has fitted up an attractive and instructive exhibit (see accompanying illustration), showing the various pieces of measured service equipment manufactured by the company, and embracing all the new ideas in controllophones.

Figs. 1 and 2 show two different views of the new steel telephone set, which contains many original features and which is bound to become an important feature in progressive exchange practice. In connection with this set, which has a self-closing door, the No. 6 controllophone is used,

E. G. LEWIS, SECRETARY CONTROLLER COMPANY.

and anyone wishing to make a call must deposit the coin or token before the operator will answer. If the desired call is not had the coin or token that has been deposited may be returned to the depositor.

Figs. 3 and 4 show the Controller company's portable controllophone and jack for outdoor use. It is compact, handy, and has proven a great success wherever used.

E. G. Lewis, secretary of the Controller Company of America, is a man of remarkable business ability, whose untiring energy and force of character have made him a power in whatever commercial enterprises he has identified himself with. He is the owner of *The Woman's Magazine*, the success of which has been phenomenal, and which has come to be recognized among advertisers as one of the greatest mediums of publicity known. To show something of this power, it need only be said that early in 1904 Mr. Lewis launched another success, The People's Mail Bank, and within nine months the entire capital stock of $5,000,000 was over-subscribed by the readers of *The Woman's Magazine!* Mr. Lewis is a man who believes in the penny from the millions rather than the dollar from the few, and the marvelous success of his undertakings attest to his business wisdom and foresight. When he started *The Woman's Magazine* about five years ago at a subscription price of ten cents a year the old heads in the magazine business laughed and predicted speedy failure for his scheme. Instead, however, success crowned his efforts, and he now runs a paper having a paid circulation greater than any other publication in existence, commanding a price of $6 per agate line for advertising, with all its space sold for several years in advance.

"I started five years ago with $1.25 and a good idea," said Mr. Lewis, and anyone who has seen the home that this "idea" has made—the monument to this faith in small things multiplied—would readily believe the assertion that he had a "good idea."

Telephone service at one cent per call is as firm an article of faith with Mr. Lewis as was the idea of a ten-cents per year magazine. Upon this faith he has staked a great deal more than many other men would risk on a principle—even on one in which they fully believed. The author of the idea of a ten-cent magazine and a bank with a million depositors knew but little about the publishing or the banking business when these institutions were launched, but he had faith in his own convictions, and had no trouble in finding men who knew the details of each business, to run the machinery, while he kept his eye on the main issues. Such is the manner of man who sees for the telephone business a future worthy of his earnest attention.

The Controller Company of America was formed by Mr. Lewis about three years ago, and the story as told by him is quite interesting. TELEPHONY quotes his own words, as follows:

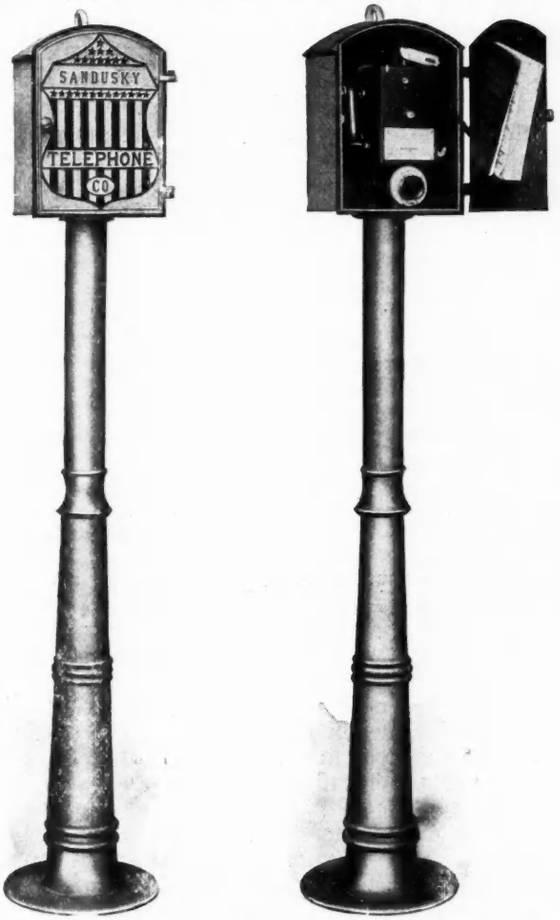
"At the time when my paper was yet quite small and I was wrestling with the financial problems involved in such an enterprise, I ordered a Bell telephone put in my house; it was one of the kind where I settled with the company each month for the number of calls used. I had a number of neighbors who found it convenient to join with me in the accumulation of my monthly telephone bill, which I had to foot. I did not feel that this was right, and looked about for a way to change it. I did not feel like refusing to let my neighbors use the telephone and did not want to appear small by telling them that their calls cost me five cents each, although I felt that they could just as well afford a telephone as I, so I rigged up an attachment whereby the receiver hook could not be lifted until a nickel had been deposited, and told my neighbors that I had put it on to keep check on the operator who kept my count. I

HAROLD D. STROUD, ENGINEER CONTROLLER COMPANY.

was not bothered so much thereafter, and soon learned that one of the neighbors had ordered in a telephone of his own. Thus I saved myself a good deal of inconvenience and made a new patron for the telephone company.

"I did not know anything about the telephone business, but I began to wonder if this was not a possible solution for an existing evil. I wondered if my experience was not about the same as thousands of others, and so at leisure moments I arranged to try it further by having some more of the little boxes made. I arranged with a few friends to

try them and the results of their experiences were so uniform that I decided that I had struck upon a good idea and laid my plan before a friend (the president of the



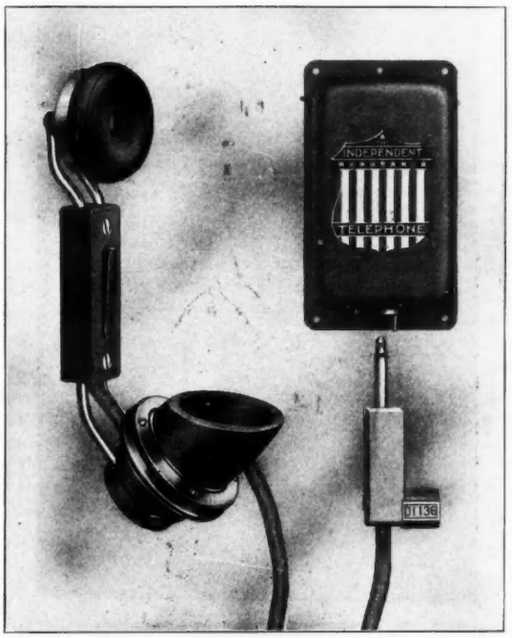
FIGS. 1 AND 2. CONTROLLER COMPANY'S STREET TELEPHONE.

Fourth National bank of St. Louis, now president also of the Controller company). He saw the possibilities in the idea, and we organized the Controller Company of Amer-

CONTROLLER COMPANY'S PORTABLE TELEPHONE CONNECTED.

ica, so called because we had spoken of the device as a controller. We knew that the form of the device then used would not meet the regular requirements of the telephone service, and so we employed some electricians to work out the idea and develop a machine that would.

"Over two years were consumed in experiments and with the result that we had quite a curiosity shop of models, and patents galore, but we did not have what we wanted to carry out our idea in a way that would permit of its universal adoption. During this time my publishing business had rolled itself into a structure of gigantic proportions,



CONTROLLER CO.'S PORTABLE TELEPHONE, PLUG AND JACK

and my attention to this and the organization of the postal bank (which, according to my plans, was about ready to launch) was needed to the exclusion of all other issues, so I decided that this pet idea, in which I had and still have unbounded faith, must either halt or I must find the man fitted to carry it on, who could give it his undivided attention. I had heard through my secretary of a young

CONTROLLER COMPANY'S EXHIBIT, MONADNOCK BLOCK.

man who had a device that just met my ideas of what was required to carry out my plans. I wired him to come to

St. Louis and we made a deal with him. I turned over to him the whole proposition, with our financial co-operation, and gave him *carte blanche* to go out and get results. Ten months is a very short time in which to give much of an

F. F. SAPP.

idea ordinarily of what a proposition of this proportion will develop, but we feel that the results thus far have been by far better than we hoped to attain in twice the time, and as a result we have planned to increase the capital of the

C. C. CURTIS.

Controller company to $1,000,000 in February, and put Mr. Stroud in a position to carry out his aims and ours unhampered."

The Controller Company of America at the present time is making some important experiments at Sandusky, Ohio, in measured service. The company's plan is on entirely new lines and is being watched with considerable interest by telephone men generally. The work at Sandusky is in charge of Frank F. Sapp, who some time ago became identified with the Controller company. Mr. Sapp is one of the pioneers in the Independent field. Since 1893 he devoted his entire time to telephone work as a promoter and builder of telephone exchanges, and from 1899 up to the past summer he was advertising manager of the North Electric Company, Cleveland, Ohio. In speaking of the Sandusky experiments Mr. Sapp said that the work was moving on nicely and that the plan was proving profitable to the subscriber, the telephone company and the Controller company, and that by spring he hoped to be able to furnish a complete story of the Controller company's new idea in measured service. Mr. Sapp is ably assisted in the Sandusky work by Carl C. Curtis, general manager of the Sandusky Telephone Company, both of whom are working under the personal direction of Harold D. Stroud.

KAISLING SELF-SOLDERING PROTECTOR.

The American Electric Fuse Company of Chicago, New York and Atlanta, states that it has distributed over 1,000 sample Kaisling protectors upon requests received from various parts of the country during the past three months and that without a single exception every recipient of these samples who has acknowledged the same has written in words of commendation of the Kaisling protector. Since this protector was first produced by the American Electric Fuse Company a number of improvements have been made in its construction, which will undoubtedly meet with approval in the telephone field. Among these improvements is a platform contact on the only operating spring in the talking circuit. It is said that the Kaisling is the only protector having platinum contacts in the talking circuit. The Kaisling protector now is also made without any cross connection through the protector base. The line connections are soldered, no screw connections appearing in the entire protector.

The American Electric Fuse Company states that the forms of protectors heretofore made have all been arranged for cross connections through screws and bolts. Any screw or bolt becoming loose made a defective contact, and, owing to the inaccessability of the parts when the protector was installed in the frame, such difficulties were naturally difficult to correct. In the Kaisling protector there is only one contact not permanently soldered. This contact is platinum, as has been noted. The test plug furnished with the Kaisling protector is said to be one of the simplest and easiest working test plugs ever put on the market. When the regular tests are to be made the plug can be inserted and withdrawn from the protector spring without disturbing the protector in any way.

The American Electric Fuse Company has received orders for thirty-two complete installations since November 1, embracing a total of over 24,000 Kaisling protectors. The company states that since it first placed the Kaisling protector on the market it has received a total of 1,848 letters from telephone companies requesting information and prices upon the Kaisling protector. This is certainly a remarkable record and speaks well both for the protector itself and the advertising enterprise of the company.

The American Electric Fuse Company received from the official award committee of the St. Louis World's Fair a certificate showing the highest award upon the company's exhibit of telephone protective apparatus. This official certificate is a very handsome document and includes the blue ribbon awarded to the first prize. A number of duplicates of the official award have been ordered by the company for the use of its various branch offices. The company is re-

ceiving the congratulations of its friends for having carried off the highest award in its class at the exposition.

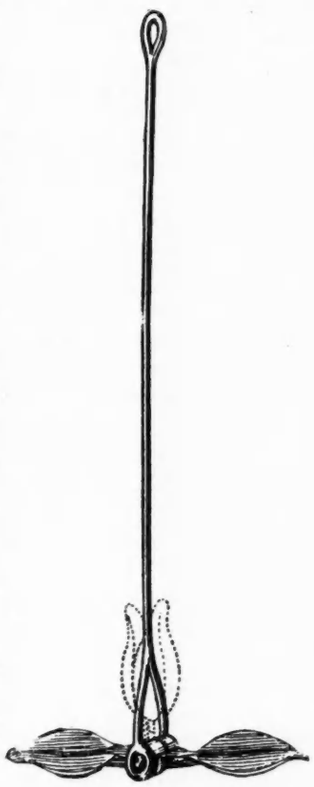
POLK ANCHOR INVADES NORTH.

One of the newest offerings in the market, of interest to telephone men, is the Polk anchor, manufactured by Robert H. Polk of Memphis, Tennessee. It is claimed that the Polk anchor is far superior to anchors bored or driven into the earth, or anchors in which the largest holding area is within the hole bored for installing anchor. When an anchor is either driven or screwed into the earth and strikes stone or rock of ordinary size, it is stopped, and it is necessary to dig out the anchor to install it at another point; whereas in the case of the auger used to install Polk anchors, it will take out rocks and stones the size of one's fist. The auger has been successfully used in installing these anchors in chirt, which is a very hard, disintegrated lime stone, used for paving roads through parts of the south.

ROBERT H. POLK.

The Polk anchor has the advantage of depending for its strength entirely on the blade extending into the solid portion of the earth, and not on that portion of the earth packed into the hole and which must necessarily give, as it has been disturbed. This anchor has been used by a number of companies in the south in single blade form for the past two or three years, but has only recently been shown in northern markets. Mr. Polk's anchor is protected by patents embracing over thirty claims, covering various forms of single blade and multiple blade anchors.

In the Polk anchor of the folding type, the blades are smaller in the center and are pivoted in a clevis on the end of the guy rod in such a manner that they fold up against the rod so that they can be inserted in a hole previously bored by a suitable auger for their reception. When the earth is packed in the hole, owing to the peculiar construction of the blade, having lips outwardly turned, it is impossible for them not to open as soon as a strain is made on the eye of the anchor rod; on opening, the full length of the blade is extended into solid earth that has not been disturbed by the auger. As the strain continues, the anchor rises six or eight inches before becoming permanently set, giving the blades a chance to open. One of these anchors can be set in about twenty minutes.



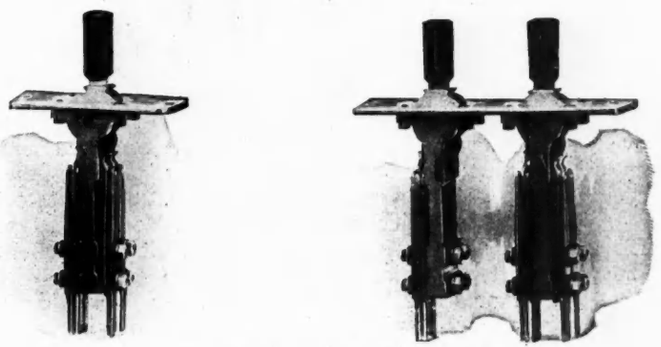
POLK GUY ANCHOR.

Mr. Polk has been in the telephone business over twenty-five years, having begun his work in the telephone exchange at Richmond, Virginia, in 1879 at the age of 14, and before the Blake transmitters came into use. At that time the subscriber held one ordinary Bell receiver to his ear and another to his mouth and did considerable yelling in order to be heard, and the average work of the boy operator for twelve hours was 125 connections, the operator making these connections usually covering from five to ten miles a day traveling around the operating room. In 1882, Mr. Polk was transferred to Birmingham, Alabama, filling various positions, and in 1883 was made manager of the exchange at Montgomery, Alabama, at which place he successfully conducted the business until 1890, during which time he gave to the telephone world his invention of the common return wire, which has so generally been used by both the Bell and Independent companies, where metallic circuits have not been installed. In 1890 he was made manager of the exchange at Savannah, Georgia, and remained there in that capacity until the spring of 1899. He then resigned and accepted a position as general manager and engineer of the Georgia Telephone and Telegraph Company, then building in Savannah. He engineered and put in successful operation one of the first Independent plants, constructing the same on a standard equal to the best work being done by the Bell company. In 1901 Mr. Polk accepted the management of the People's Home Telephone Company, at Birmingham, Alabama, after S. B. Claypool became general manager of the Seattle company. Mr. Polk remained in Birmingham until January 1, 1904, when he accepted the position of general manager of the Memphis (Tenn.) Telephone Company.

In addition to giving the telephone world the Polk knob and the Polk anchor, Mr. Polk has invented a number of improvements in telephone circuits, which are now being used in several places.

THE MONARCH RINGING AND LISTENING KEY.

In estimating on a switchboard it is customary to figure one cord equipment to every ten lines. It is, therefore, safe to say that the keys receive ten times as much wear as the drops and jacks. If this is so, too much care cannot be taken in the manufacture of these parts. The Monarch Telephone Manufacturing Company of Chicago seems to have realized this point when designing and building its ringing and listening key, with the result that an extraordinarily substantial key has been produced. Little details have been carefully considered, and the workmanship is fully up to the Monarch standard.



MONARCH RINGING AND LISTENING KEY.

As will be seen from the accompanying cuts, the mounting is heavy. It is made from a solid brass rod drawn up to the exact shape in long bars, and then cut to the proper width. At the top the mounting is milled out for the reception of the rollers and the cam. The cam is also made of brass, and fits into the milled slot of the mounting so that the rollers are held in place without the aid of screws and washers. The pin on which the rollers revolve is part of the cam, thus reducing the number of small parts and lessening the chance for trouble. The rollers are of hard rubber, and merely slip over the pins on the cam, the

mounting frame holding them in place. This construction makes it impossible for a roller to work loose and drop out of the key, and also allows for a larger roller, which makes the action more even and smooth.

The brass frame is securely fastened to an escutcheon by four machine screws put in from underneath. The top of the escutcheon plate is therefore left smooth. This escutcheon is steel, with a Bauer Barrf finish, while the part of the cam projecting through is nickel-plated, but not polished. A pleasing effect is thus secured, and at the same time a most durable finish. At the top of the cam on each side is a shoulder. This is used as a stop, as the shoulder meets the escutcheon when the cam is thrown over, and stops further movement.

Just below the cam handle will be seen a hexagon nut. This nut is part of the screw which holds the handle to the cam, and is left there to save trouble in case the screw breaks. The part of the screw beneath the nut is heavier than the part holding the cam handle, so if a break occurs it will be above the nut. The nut will then afford an easy method of removing the broken end and a new screw can be put in without difficulty. These little points of construction add to the value of a piece of apparatus as they sometimes save hours of time and unlimited inconvenience.

All springs are German silver, and every contact both on the listening and ringing side is pure platinum. The separators between the springs and the bushings protecting the screws are hard rubber. With the solid brass frame as a base, the springs are afforded a substantial mounting. Two long brass screws extend through one set of springs, through the brass frame, and then through the springs on the opposite side, and are equipped with nuts and washers, thus locking all of the parts together.

All Monarch switchboards are equipped with keys as described above, and as would be expected from the construction, reliable and satisfactory service is being given. For further particulars regarding the switchboard and telephone apparatus, address the Monarch Telephone Manufacturing Company, 12-16 South Clinton street, Chicago.

ORDERS FOR COOK APPARATUS.

Frank B. Cook, Chicago, has received from the North Electric Company, Cleveland, Ohio, an order for the protector equipment for the new exchange of the Amsterdam Automatic Telephone Company of Amsterdam, New York. The order calls for Cook's type "L" distributing frame, 1,200 pairs capacity, equipped with Cook's No. 444 self-soldering protector. The North Electric Company also gave Cook an order for a type "L" frame equipped with 100 pairs of No. 444 for College Corners, Ohio. Other orders which Cook has received for his No. 444 protectors are as follows: York Telephone Company, York, Pa., type "L" frame equipped with 300 pairs; Oil Belt Telephone Company, Portage, Ohio, type "L-3" frame equipped with 30 pairs; Automatic Electric Company, for Home Telephone Company, Riverside, Cal., an addition of 500 pairs; Kellogg Switchboard and Supply Company, for Cartersville (Ill.) Telephone Company, type "L" frame equipped with 200 pairs; Telluride Power Company, Olmsted, Utah, type "L-3," 20 pairs; United Telephone and Telegraph Company, for their exchange at Mechanicsburg, Pa., type "L" frame, 300 pairs; Automatic Electric Company, for the Home Telephone Company, San Diego, Cal., an addition of 300 pairs. The Louisville (Ky.) Home Telephone Company has found it necessary to materially increase its plant and has recently placed with Frank B. Cook, through the Stromberg-Carlson Telephone Manufacturing Company, an order for an addition of 800 pairs of Cook's No. 444 protector.

TELEPHONE MANNERS.

The majority of men, when they meet you on the street, or talk with you at office or shop, act and speak with the most becoming courtesy. Even if you are slightly deaf and have to be bawled at, they will do the bawling with good humor and gentlemanly patience. A man may be greatly rushed in his place of business, but if you step in he is not likely—unless a veritable bear—to show his teeth and growl. Courtesy is the rule, and rudeness is the exception.

But there is a difference when you confer with a man over the telephone—or some men. You are sometimes so shocked by a savage voice rushing along the wire that the receiver nearly falls from your hand. The most constant user of the telephone is "Central." Calls come into her ears almost without interruption. But "Central" is always accommodating, never impatient. You never hear her voice keyed up to the musical point; but always it comes, at any hour of the day or night, sweet and clear, gentle and tolerant, without a hint even of weariness.

There is not often any need of shouting over the telephone. When there is, there is no need of using a voice bristling with all sorts of fire-tipped inflections. Distance does not make the voice grow fonder over the telephone. A growl is a growl still to a sensitive ear, and there is such a thing as courtesy even at a distance.

PUSHING PROJECT IN COLORADO.

Residents of Denver, Colorado, will be able to talk over Independent telephone lines to Kansas City and St. Joseph, Missouri; Topeka, Kansas; Sioux City, Iowa; Salt Lake City and Ogden, Utah; San Antonio and Houston, Texas, before the end of another year, is the promise made by H. M. Spere, general manager of the El Paso Telephone Company, with headquarters in Colorado City.

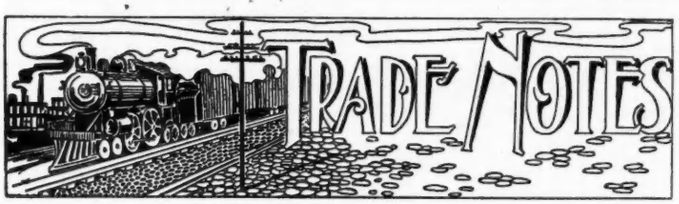
Mr. Spere has been making preliminary arrangements in Denver for the drafting of a bill to be presented to the city council asking for a franchise to operate an Independent telephone company there. This is to be done shortly after the first of the year, when a petition will be circulated in an endeavor to get twenty-five per cent of the voters to sign it, so that the council can pass an ordinance granting the privileges asked for.

It is the present intention of the El Paso Telephone Company to seek franchises in El Paso, Teller, Fremont, Pueblo and Douglas counties, and in the city and county of Denver. The capital stock is now $500,000, but it is said all the money necessary is behind the enterprise.

NEW TELEPHONE LINE TO THE EAST.

Representatives of the new United States Telephone Company, which contemplates the establishment of an Independent trunk line from Chicago to Philadelphia and New York, have made plans to buy the plants of the Independent companies in the central and eastern sections of Pennsylvania, which are in a direct line with the proposed trunk line. Among those wanted are the Independent plants at Harrisburg, Reading and Allentown, which by traffic agreement have connection with the Keystone system in Philadelphia and the Knickerbocker in New York, which will also be absorbed by the United States company. It is planned to have the new trunk line in operation within a year.

A Kansas paper says: "A young man in a neighboring county who attempted to propose to a girl over a country party telephone line a few nights ago has received four acceptances already."



THE FIBRE CONDUIT COMPANY, Orangeburg, New York, in bulletin No. 25, refers to a recent installation of its junction boxes made in the Northfield schools of East Northfield, Mass.

THE CENTURY TELEPHONE CONSTRUCTION COMPANY has been awarded the contract for constructing the entire plant for the Holley (N. Y.) Telephone Company, including all apparatus for a common battery system.

W. J. MURDOCK & COMPANY, Chelsea, Mass., manufacturers of the "Solid" telephone receiver, are about to put on the market a new exchange receiver, which they say surpasses anything they have heretofore made.

THE AMERICAN ELECTRICAL WORKS, Phillipsdale, Rhode Island, which makes a specialty of telephone cables, has issued a net price list and discount sheet, applying to its catalogue of May, 1903, which will be sent upon request.

THE REED ELECTICAL CORDAGE COMPANY has been incorporated at Syracuse, New York, with a capital of $50,000. The company will begin operation about January 1 and will manufacture insulated wire, magnet wire and telephone cord.

THE EWING-MERKLE ELECTRIC COMPANY, St. Louis, has issued an attractive catalogue illustrating and describing in full its complete line of electrical novelties and appliances. It is an interesting and entertaining little document and will be sent to any one upon application.

THE NORTH ELECTRIC COMPANY, Cleveland, Ohio, has just issued two new bulletins—Nos. 24 and 25—relating to the North permanently adjusted receiver and its type "K" magneto telephones. Each is freely illustrated and either or both will be sent upon application.

THE NORTH ELECTRIC COMPANY, Cleveland, Ohio, has established a branch house at Dallas, Texas, which was opened for business December 15. This branch house is in charge of A. A. Miller, who has been connected with the sales department of this company at Cleveland for some time.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Chicago, is pushing the sale of the Burns adjustable telephone, for use on either flat or roll top desks. It is neatly constructed, a space saver, and will be furnished in any length desired. Prices and catalogue will be furnished upon request.

THE AMERICAN ELECTRIC FUSE COMPANY, Chicago, New York and Atlanta, is issuing some very interesting circular matter on the subject of the well-known Kaisling self-soldering protector. Those contemplating the purchase of any new protector equipment will be interested in the new circular of this company.

THE WILEY-EMERY COMPANY is the name of a new firm organized at Seneca, Kansas, by W. A. Wiley and Judge Emery, for the purpose of manufacturing and selling a machine for raising telephone and telegraph poles and like construction work. The machine is the invention of Mr. Wiley, who has secured a patent on the device.

THE MARTIN TELEPHONE COMPANY of Webster City, Iowa, has placed a large order with the Controller company of America for its educational service controllophones. E. H. Martin, head of the company, states that he already has a development of 1,000 telephones in and about Webster City, and that there are still 1,200 places where he can put instruments on the new plan.

CHARLES TOWSLEY, formerly with the Putnam Telephone Company at Ottawa, Ohio, is making preparations for the establishment of a telephone and electric motor factory in that city. The concern will be known as the Towsley Electrical Company, and while it will start on a modest scale it promises to develop into a flourishing business in time. The machinery has been purchased and will be installed upon its arrival.

THE KNOX-DICKEY TELEPHONE MANUFACTURING COMPANY, Portsmouth, Ohio, which manufactures the well known four-party selective signaling telephones bearing its name, for common battery and magneto systems, has issued a booklet describing in detail its apparatus and working of same. A copy of this pamphlet will be sent upon application, and exchange managers will be sure to find it of interest.

THE contract has been let for the building of a new factory for the American Electric Telephone Company, Chicago, to be situated at State and Sixty-fourth streets, the property consisting of a twelve-acre tract. The factory will cost approximately $150,000, and the building will be ready for occupancy May 1, 1905, at which date the company will move from its present location at 36-58 West Jackson boulevard.

THE STANDARD TELEPHONE AND ELECTRIC COMPANY, Milwaukee, Wis., is sending out to exchange managers one of the neatest souvenirs ever issued by the telephone trade, the same being a miniature transmitter button to be worn on the lapel of the coat. The button is finished in gold and is a very neat affair. Any exchange manager desiring one of these buttons will be sent one upon application to the Standard company.

THE MILLER ANCHOR COMPANY, Norwalk, Ohio, states that its sales on anchors and augers are constantly and steadily increasing. The sensible way of installing the anchors, which can be done without fear of injuring them, together with the low prices, appeal to every company where time, labor and money are items worth considering. All inquiries are promptly answered, and catalogues are gladly sent upon request.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, reports a large and increasing demand for its self-restoring drop switchboard equipment and long-distance generator-call telephones. The International company has made rapid progress in introducing its high-grade equipment in many sections throughout the United States and is also taking the lead in the foreign business against the European manufacturers.

MACHADO & ROLLER, 203 Broadway, New York city, are sending out to the trade illustrated circulars announcing the fact that they are general selling agents for the Roller Direct Reading Bond Tester, manufactured by the Whitney Electrical Company of Penacook, New Jersey, which also makes a full line of voltmeters, ammeters, ohmmeters and

wattmeters for all styles and classes of work. Printed matter and other data sent upon application.

THE CHICAGO TELEPHONE SUPPLY COMPANY, Elkhart, Indiana, has just received the first of an order for the equipment of the El Paso Telephone Company which will supply the needs of Colorado Springs, Colorado City, Manitou, Victor, Cripple Creek, Florence and Canon City, Colorado. Each town's system will be completed at a time, and eventually the order will aggregate at least 10,000 boxes. The Elkhart company will furnish the telephones and the exchange supplies.

THE COMMERCIAL ELECTRICAL SUPPLY COMPANY, St. Louis, which deals in telephones, switchboards, protectors and general telephone supplies, is sending out a unique mailing card advertising its high-grade Commercial incandescent lamp. At the top of the card secured in a little circular hole is a copper penny, which aids in impressing upon the mind of the recipient of the card that "It only costs one cent to find out the merits of the Commercial incandescent lamp."

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, New York, and Chicago, is out with one of the handsomest catalogues of the season describing in detail its splendid line of toll boards. The catalogue is printed on heavy calendar paper and is beautifully illustrated. The cover design is done in colors and carries out a most novel conception, tending to show the wide use of the Stromberg-Carlson toll boards. The catalogue is a work of art of its kind; it will be sent upon request.

THE F. BISSELL COMPANY, Toledo, Ohio, reports an increased demand for its "Security" conduit rods. These conduit rods were recently put through some very severe tests by the Home Telephone Company, Toledo, Ohio, and the results were highly gratifying to the manufacturers. Besides being low in price, they possess qualities which makes them the most desirable rods on the market—light in weight, quickly jointed and unjointed, without slack at joints, yet rigid, and will not buckle or jam under pressure. Made in thirty-six and forty-eight inch lengths; special lengths to order.

THE COMMERCIAL ELECTRICAL SUPPLY COMPANY, St. Louis, evidently believes in up-to-date and seasonable methods in the matter of spreading its fame through the agency of printer's ink. As a holiday souvenir—and a gentle reminder every day during 1905, by the way—it is sending out to its friends a handsome black leather-bound diary, with the name of the company stamped in gold on the front cover. The little work, aside from being a volume wherein to chronicle daily events, is a veritable compendium of practical electrical knowledge, as well as containing other useful information. The enterprise of the Commercial company in this particular is commendable.

THE EDMONSTONE COMPANY, 105 Chambers street, New York City, announces that it has secured all rights, title and interest in and to the Anders push button telephone. These patents were formerly owned by the American Push Button Telephone Company. The Edmonstone Company secures all of the letters-patent, trade marks and patterns covering the Anders push button type of telephone, and will in the future be the sole manufacturer of this apparatus and accessory parts thereto. The effects of the American Push Button Telephone Company were sold under an order of court to satisfy its creditors. The Edmonstone Company is incorporated for $100,000, its stock is fully paid, and its available cash capital is such as to justify a vigorous campaign. The company is publishing a new catalogue descriptive of its telephone devices. Wiring diagrams and specifications will be sent on request, and discounts will be quoted to dealers interested in this apparatus. The Edmonstone Company represents an entirely new combination of capital.

THE COMMERCIAL ELECTRICAL SUPPLY COMPANY, St. Louis, has made arrangements with the Vought-Berger Company, LaCrosse, Wisconsin, for the exclusive sale of its well known apparatus in the territory comprising Missouri, Oklahoma, Indian Territory, Texas, Arkansas, Louisiana, Mississippi, Western Kentucky and Tennessee. A telephone department has been established by this company for the handling of this line, and the number of orders which it is obtaining indicates that the goods are giving excellent satisfaction. A new catalogue has been issued and is being distributed by the Commercial company.

THE SWEDISH-AMERICAN TEEPHONE COMPANY, Chicago, whose advertisement appears in this issue, has recently shipped complete exchange equipments to the following named companies: Juniata Independent Telephone Company, Juniata, Neb.; Ayresville Mutual Telephone Company, Ayresville, Ohio; Staplehurst Telephone Company, Staplehurst, Neb.; Mount Zion Telephone Company, Petroleum, Ind.; Brainard Independent Telephone Company, Brainard, Neb.; Inter-State Telephone Company, Wilsonville, Neb.; Edwards Telephone Company, Forsythe, Mont.; Independent Telephone Company, Montezuma, Iowa; Witty Telephone Company, Appleton City, Mo.; Marshall Telephone Company, Ayr, Neb.; Viking Telephone Company, Rake, Iowa.

THE MONARCH TELEPHONE MANUFACTURING COMPANY of Chicago has just closed an order for 200 telephones and a large amount of construction material, as well as telephone and switchboard parts, to be shipped to Guayaquil, Ecuador. The instruments are the standard Monarch No. 30 series sets equipped with the latest devices of the Monarch company. The company at Guayaquil has succeeded in building up a good business and reports that the native South Americans are enthusiastic users of the telephone, as they can thus talk most outrageously to their worst enemies and still feel moderately sure that a stiletto will not come into play the next instant. The Monarch company guaranteed that its transmitters would transmit any speech, no matter what the language might be or how it was spoken. Shipment of the apparatus was made December 20 and the goods will arrive in Guayaquil about February 5, 1905.

GREAT AMERICAN TIME SAVER.

Not so long ago it was considered quite a luxury to have a telephone in your hotel room, but lately this has become a common necessity. There is a company in Chicago which is now installing private-house circuits on the electric bell wires. By this convenience milady may call up the cook from the secure fastness of her boudoir. The butler or the coachman are reached in the same easy manner, and the cost is trifling. There are ministers in Chicago and New York who do most of their business over the telephone. It has become the great American time-saver. It is even thought perfectly proper to discuss important matters over the wire. This was a long time coming, but they are all falling in line. Three years ago when one called up a rectory and asked to have the pastor come to the telephone it was more than probable that he would be reminded that "this matter could not be discussed over the wire." Now even such a sedate and dignified prelate as Archbishop Farley or his coadjutor, Monsignor Cusack, does not hesitate to talk freely over the wire.

Present State of Wireless Telegraphy

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IN response to a request to contribute a paper on wireless telegraphy to the Congress, the writer has made it his aim to present a broad general statement concerning the present state of the art, rather than to offer any special contribution to new knowledge on the subject. In view of the exclusive position occupied by wireless telegraphy as conducted by Hertzian waves, it may be taken that references to any other methods are hardly necessary and that when we speak of wireless telegraphy at the present date everyone understands this to mean the method of Hertzian waves, originated by Mr. Marconi. In discussing this subject before the present audience there will be no need to enter into explanations of elementary facts and principles. We may at once proceed to describe the forms of apparatus now in use and the extent to which the functions of the various parts have been determined.

Up to the present time no one has discovered any method for producing a powerful electric wave of the Hertzian type which does not involve or depend upon the oscillatory discharge of a condenser of some kind. Necessarily, therefore, this process is intermittent. The condenser has to be charged and then discharged, and this process results in the production of a group of decadent oscillations and waves and the process is then repeated. Generally speaking the frequency of the oscillations employed in wireless telegraphy is of the order of a million, and from 20 to 100 oscillations may form a group. The frequency of the charge and discharge period may be from 10 to 100. The time over which the oscillations extend is, therefore, as a rule, not much more than one per cent of the whole time. In other words the actual radiation is taking place only at most during about one-hundredth part of the time the operations are continuing. This fact has induced many inventors to hope for a more efficient method which shall consist in manufacturing a continuous train of waves resembling those emitted by an organ pipe rather than a series of intermittent explosions. Although alternators have been made, giving a frequency of 120,000, it is without doubt beyond the limits of practical achievement to construct an alternator having a frequency of a million. In spite of the statements made that low-frequency alternations of frequency, say of the order of 100, give rise to correspondingly long electric waves of wave length $3\times10^{10}/n$ centimeters, where n is the frequency, the author believes that this is not the case, and that to detach a true free electric wave from a radiator it is necessary to have a certain far higher frequency, perhaps not sharply defined, but at any rate involving a relatively very sudden reversal of electric force. The same is the case with the production of a wave in air or water. In order that the energy may be detached from a wave-making vibrating body in air or water and travel away through the medium in the form of a free wave, it is necessary that the reversal in direction of the mechanical force, or which comes to the same thing, the acceleration positive or negative of the wave-making body, shall exceed some limit. Otherwise there is no detachment of energy. To put the matter in a popular form, the blow administered to the fluid must be sufficiently sudden to call into operation the inertia quality of the medium, in order that a wave may be detached.

The loudness of the sound produced by an explosive depends quite as much, if not more, upon the suddenness of the explosion as upon the energy stored up. It has been found, for instance, that four ounces of gun cotton exploded in the air will yield a sound quite as loud as that given by three pounds of gunpowder. On the other hand, the production of a continuous sound from a steam- or air-siren for coast-signal purposes, involves very large amounts of power; as much as 600 horsepower having been in some cases consumed. Reasoning from analogy, the inference is probably correct that the production of a solitary ether wave involves the reversal, with a certain ill-defined but high degree of suddenness, of an electric force, and that the amplitude of the disturbance, and hence what may be called its space-penetrating power, depends quite as much, if not more, upon the extreme suddenness of its creation as upon the amount of energy employed.

All the electric wave generating appliances at present in use in connection with wireless telegraph transmitting plants involve, therefore, (i) an arrangement consisting of a condenser, inductance and disruptive spark-gap in series with each other. (ii) Some apparatus such as an induction coil, transformer or high tension alternator or high tension dynamo for charging the condenser and (iii) means for controlling the repeated discharges and cutting them up into groups as required in accordance with some signaling code. The possibility of setting up electrical oscillations in the condenser and inductance circuit by the above arrangement depends essentially upon the peculiar property of air and other gases, viz., that whilst they are very perfect insulators for electric forces less than a certain value, they pass instantly into the condition of a conductor when the electric force exceeds this value. When we are operating on a layer of air at a pressure of 760 mm or so, of about one millimetre in thickness, it is fairly correct to say that an electric force of 4,500 volts per millimetre, (equivalent to 150 electrostatic units) forms the limiting value at which this transformation takes place. This rule holds good when the bounding surfaces are metallic balls of one or more centimetres in diameter.

If we are operating in air at greater distances, say one centimetre or more, then we may say that the limiting electric force approximates to a force of 100 electrostatic units. It is well known that the dielectric strength of very thin layers of air is greater than that of thick layers and also that the potential difference required to produce a spark, however short, cannot be less than a certain value which for air at atmospheric temperature and pressure is about 300 to 400 volts.

Again, the potential difference required to create a spark of given length is greater for large discharge balls than for small ones, and the value attains a maximum as the discharge surfaces approximate to planes. When the discharge takes place in air above normal or atmospheric pressure, the electric force required to begin the discharge between metal balls, say 10 cms in diameter, the air pressure being x atmospheres, can be calculated from a formula given by Wolf (*Wied. Ann.* 37. 306, 1889) which is

$$E = 107x + 39$$

E being the electric force in electrostatic units. This formula holds good from one to five atmospheres or up to 70 pounds on the square inch. According to Paschen's Law (See J. J. Thomson "Conduction of Electricity Through Gases" p. 367.) spark potential depends only upon the product of spark-length and gas pressure, i. e., upon the mass of gas between the electrodes.

For a given potential difference, the spark length, for

Paper read at the International Electrical Congress at St. Louis.

lengths greater than about one mm, varies almost inversely as the pressure. Thus in air at normal pressure, the spark length between balls one inch in diameter would be about seven mm for 20,000 volts and if the pressure is increased to 42 pounds on the square inch the same potential difference will create a spark of about two mm in length.

In connection with this subject of a spark discharge in air of greater normal pressure, the writer may mention that he has during the past winter conducted some experiments on wireless telegraphy across London between University College and his own private house, the distance being about four miles. Working with a certain aerial and employing a Marconi receiving arrangement, very good results were obtained by the employment of a seven-mm spark in air at ordinary pressure, the capacity employed being 1/110 of a microfarad. In comparison with this, experiments were made with an arrangement devised by the writer for working with discharges in air at greater than atmospheric pressure. The discharge surfaces were two steel balls one inch in diameter and when these were placed two mm apart in air at forty pounds pressure, even better signals were obtained than when working with a seven or eight-mm spark in air at ordinary pressure. On the other hand, whereas the air spark was exceedingly noisy, the two-mm spark taking place in a cast-iron vessel in air under forty pounds pressure was absolutely silent.

The importance of employing a perfectly silent discharger on board ship is very considerable. Great annoyance is caused to passengers who have cabins in the vicinity of the wireless telegraph cabin on board passenger ships by the noise of the spark and moreover, if the messages are not sent in cipher, anyone who can read the Morse alphabet hears what is being said.

It has become usual to include the spark balls in a glass vessel and in some cases in working Tesla coils, instrument makers have begun to employ such glass vessels to contain compressed air, the spark balls being included in it.[1] This, however, is a dangerous proceeding, as even thick glass is rendered brittle in course of time by the action of the radiation from the spark and if the vessel contains compressed air an unpleasant accident may happen. Moreover, such a vessel will not render the spark perfectly noiseless. This can only be done by employing, as the writer has done for some time past, a cast-iron vessel with thick walls which are perfectly rigid and elastic and in which the spark balls are contained and insulated.

One drawback which presents itself when working with a discharge spark in compressed air is the continual production of nitric acid in the interior of the enclosed vessel. This difficulty is only partly overcome by introducing caustic potash or quicklime into the interior of the closed chamber. A better plan is to take the spark in compressed nitrogen. This gas can be prepared quite easily in sufficient quantity by burning pieces of phosphorus within a small closed gasometer full of air, standing over water. This nitrogen generated can then be pumped into the closed cast-iron vessel containing the spark balls by the aid of such a hand pump as is employed for inflating the tires of motor car wheels, and when once the vessel has been filled with nitrogen under the requisite pressure, no further difficulties as regards the production of acid vapors will occur and it need only be renewed at considerable intervals.

Certain other difficulties, however, occur when using very short sparks and large capacities, because then special arrangements have to be made to destroy the arc discharge. It need hardly be pointed out that if the transformer which is charging the condenser continues to send its own discharge in the form of an alternating arc between the spark balls after the oscillatory discharged is finished, the condenser cannot be charged again until this arc is extinguished. One attempt to obviate the necessity for any discharge at all in producing electrical oscillations from a condenser, has been in the application by Mr. Cooper-Hewitt of the well known properties of mercury vapor of passing into a conductive condition only when the applied electric force exceeds a certain definite value. He employs instead of the spark gap a mercury vapor electric lamp in conjunction with an inductive resistance. As soon as the condenser has become charged, a current traverses the lamp and at that moment the difference of potential at its terminals is enormously reduced and the condenser therefore discharges or feeds a circuit between itself and the lamp in which it sets up electrical oscillations.

It is characteristic of these lamps that they may be constructed not to pass an appreciable amount of current below a given voltage which can be determined, and therefore at the end of certain definite periods the current ceases to pass and the light goes out.[2] Since the operation is continuous, it is concluded that the result is to furnish a non-intermittent series of electrical oscillations. It may be remarked, however, that the arrangement is only electrically equivalent to that which is now known under the name of the Duddell singing arc, in which a continuous-current electric arc has its carbons short circuited by a condenser and inductance in series with one another. Under these circumstances the continuous series of discharges from the condenser take place through the arc. Any device will effect this continuous operation which has properties similar to that of mercury vapor or the carbon vapor in the continuous current arc, viz., that the passage of a large current through the medium greatly lowers the potential difference between its terminals.

Although, however, it has been asserted that the employment of the Cooper-Hewitt mercury lamp in place of the spark gap would result in very great advantages, the writer has not been able to verify this statement, and in the only case which has come to his knowledge where the attempt was made to use the device with powerful discharges, it was not successful. Careful consideration of facts connected with the production of electric waves shows that the production of a powerful wave is not merely a question of energy, that is to say, not merely of energy stored in the condenser; it is very greatly dependent on the mode of release of this energy and it is astonishing what results in ether wave-making can be achieved with extremely short sparks, that is with comparatively low voltages, if only the nature of the discharger is such as to permit an extremely sudden release of this energy.

It has been asserted by Fessenden[3] that the wave-producing effect of a given amount of energy can be greatly increased by taking the spark in air under a pressure greater than sixty pounds per square inch, and that by operating in air at eighty pounds pressure per square inch, the intensity of the radiation was enormously increased compared with that obtained when working at fifty pounds; this improvement being quite apart from any question of the diminution of length of the spark in the increased air pressure. It is quite possible that such an improvement may come about, owing to the greater suddenness with which the dielectric gives way in the case of air under greater pressure than eighty pounds per square inch. The writer has not, however, been able to verify this fact and has met with some obstacles and complications due to the difficulty in suppressing arcing when very short sparks in high pressure air are employed.

For telegraphic purposes the spark must have a certain

1. See Mr. F. J. Jervis-Smith. "On a High Pressure Spark-Gap Used in Connection with a Tesla Coil." *Phil. Mag.*: August, 1902, Vol. 4, Series 6, p. 224.

2. See Brit. Patent Specification, No. 9206 of 1903, P. Cooper-Hewitt.

3. U. S. Letters Patent, 706,741. Aug. 12, 1902.

quality, which may perhaps be defined by saying that the discharge between the balls must be wholly due to the energy coming out of the condenser and not to any supplied directly by the voltage-producing device, whether transformer or alternator or induction coil. Moreover, these sparks must succeed one another with great uniformity and regularity.

As long as we are dealing only with the small amounts of power, that is, with such small capacities as may be obtained by the use of Leyden jars charged by induction coils, no difficulty arises in connection with the disruptive or oscillatory spark discharge, except perhaps the great noise made by it. This is certainly very objectionable, but may be obviated by enclosing the discharger, as above described, in a suitable cast-iron vessel with very thick walls. A peep-hole or window closed by a thick disc of glass, or a lens, permits inspection of the spark, and with this arrangement the discharger can be made perfectly silent. When, however, we employ large capacities and attempt to discharge across the gap electric energy, say equal to 100 joules at each discharge, the charging voltage being 20,000 or upwards, we meet with special difficulties. Discharges of this character tear away and destroy the surface of metal balls, and thus alter the nature and length of the spark gap and also we have superimposed upon the oscillatory discharge of the condenser, an electric arc discharge proceeding from the charging transformer.

At a very early stage in the attempt to use large powers for electric wave generating plants, the writer had to deal with these difficulties by the construction of devices for overcoming them. The simple arrangement of a pair of brass balls half an inch in diameter connected to the secondary terminals of an induction coil, which constituted the discharger used in early wireless telegraph experiments, is applicable only when very small discharges, having energy, say of one to ten joules, are in use. In the case of more powerful arrangements, the discharger becomes a very important element and the design of a suitable appliance requires great experience. The particular arrangements devised for this purpose by the writer, which have been very successful, cannot be described in detail at present, as they are confidential.

The next important element in the transmitting arrangement is the condenser. It has been customary to employ for this purpose the ordinary Leyden jar or at least a glass tube, partly coated inside and out with tinfoil. The Leyden jar is, however, very bulky in comparison with its electric capacity, but it has the advantage that there is but one edge to the tinfoil from which glow-discharge can take place. It still continues to be employed to a very large extent for small land and ship plants, and a jar having a capacity of about 1/700 of a microfarad is in general use.* For larger powers, Leyden panes or glass plates, coated with tin-foil and immersed in linseed oil or vaseline are employed. The glass must be carefully selected and free from flaws, as if used in series, the failure of one condenser is followed by that of all the others in the series.

The writer has made numerous experiments on different materials as dielectrics for condensers for this purpose. Micanite has greater dielectric strength than glass, but taking cost per unit of energy stored into account, no dielectric is cheaper to employ than good sheet glass. Materials, such as ebonite, oiled-paper or paraffin are quite unsuitable for constructing condensers required to yield very powerful electric oscillations. It may be remarked in passing that it is impossible to store up in glass, in the form of energy of electrostatic strain, more than about forty to fifty foot-pounds per cubic foot of glass. The limit is fixed by the dielectric strength of glass and the figure shows how small is the electrostatic energy-storing capacity of a dielectric compared, say with the mechanical energy which can be stored in a cubic foot of compressed air. We require 500 cubic centimetres of glass to store up in it one joule of electric energy in the form of electrostatic strain.

In connecting up large numbers of condensers, so as to form a large capacity, it is important to pay attention to the equalization of the lengths of the discharge paths of each condenser. The writer believes he was the first to draw attention to this matter,[4] and others have since appreciated the importance of this arrangement. So far, therefore, we may say that every form of transmitting or electric wave generating device in use in connection with Hertzian wave wireless telegraphy has involved the employment of an air spark gap, an inductance, and a condenser in series with each other, the electrical effect of the arrangement being that a series of high-frequency oscillations are produced in this condenser circuit. Such a circuit constitutes, however, a closed or non-radiative circuit; and in order that electric waves may be thrown off into space by it, it has to be associated with an open or radiating circuit. We may make a thermal analogue by considering a boiler full of hot water, the boiler being well lagged with non-conducting material. The boiler would not cool or radiate. If, however, we were to drive long metal pins through the lagging into the boiler shell and allow these pins to project beyond the covering, they would convey energy from the boiler to the air and ether outside and the boiler would radiate and cool.

In a precisely similar manner, the simplest arrangement for making the closed electric circuit radiate is to connect to it, at one point, a long straight wire or rod called an aerial or antenna, and to connect some other point on the closed circuit to the earth. In order that the arrangement may radiate effectively, it is, however, essential that the natural electrical time period of the closed circuit shall be adjusted by so selecting its capacity and inductance that it shall be in agreement with the fundamental or with a harmonic of the electrical time period of the aerial or radiating wire.

As there is no necessity to enter here into the discussion of vexed questions of priority, we need not attempt to apportion the credit for the invention of this particular arrangement. If an invention could speak and were asked how it came into being, doubtless its answer would often be similar to that of Topsy in the immortal tale of "Uncle Tom's Cabin," "I 'spect I growed." Inventions are like everything else, subject to the law of evolution. In this case, we probably have the germ of the arrangement in the experiment with a Leyden jar and two long wires described by Sir Oliver Lodge in 1888 under the name of the "recoil kick,"[5] and when Mr. Marconi had invented and intentionally applied the vertical aerial as a radiator, the obvious application of it to the closed circuit was made by Prof. F. Braun[6] but the latter did not at that time assert the necessity for a sympathetic tuning of the radiator and closed circuit and it was only after the publication of Mr. Marconi's researches on this subject[7] that the full necessity for this was realized generally. In a particular form, it has been employed by Prof. Slaby and Count Von Arco in the transmitter arrangement as made by the Allgemeine Elektricitats Gesellschaft.[8]

*Under the operation of frequencies greater than about one million, the dielectric constant of glass suffers great reduction as compared with its low-frequency value. Hence account of this fact must be taken in estimating glass condenser capacities.

4. See British Patent Specification, No. 3481 of 1901, p. 6. J. A. Fleming.

5. See Lodge. *Proc. British Assoc.* Bath, 1888. Also *The Electrician,* Vol. XXI, p. 607. "On Measurement of Electromagnetic Wave Length." Also *Proc. Roy. Soc.,* Vol. 50, 1891, p. 23. Also Lodge & Muirhead, British Patent Specification No. 11,348 of 1901.

6. See F. Braun. British Patent Specification No. 1862, January 26, 1899, and German Patent No. 111,578 of October 14, 1898.

7. See British Patent Specification, Marconi, No. 7777, 1900.

8. See an article in *Traction and Transmission,* Vol. VI, March, 1903, p. 193, where a description of the Slaby-Arco System is given

The open radiating circuit may, however, be coupled inductively to the closed circuit by the intermediation of a suitable oscillation transformer. In this case, the primary circuit of this transformer forms the inductance of the closed circuit and the secondary is in the open or radiating circuit.

The inductive coupling introduces more complexity both into the practical performance and the theoretical consideration of the arrangement. As described by Prof. F. Braun in his patent specifications, no statements were made which gave evidence that he considered the adjustment of the time-periods of the open and closed circuits essential. He has, however, since declared that he was aware of this necessity.[9] Mr. Marconi, however, who independently devised the inductive coupling and worked out step-by-step with great ingenuity the practical details necessary to make it effective, arrived very early at the conclusion that the equalization of the time-periods of the two circuits was the very essence of the invention.[10]

In the construction of the oscillation transformers used for this purpose, Marconi has generally employed square frames on which the primary and secondary circuits are wound, a very usual transformation ratio being 1:10. There is no advantage in multiplying the turns of the primary circuit as it is essential to keep the inductance of that circuit as low as possible. A modification of the foregoing is the multiple system of transformation, devised by the writer in the autumn of 1900 and first described in 1901.[11] In this arrangement, a series of two or more closed oscillatory circuits are inductively interconnected, the voltage being raised at each transformation. The final link in the chain is the open or radiating circuit and all the circuits have their time-periods adjusted to be in syntony with each other. When operated by means of high tension transformers this constitutes a very effective arrangement for producing prolonged trains of electric waves.

If we now compare the two above described wave-producing arrangements with the original method described by Marconi in his first patents, we shall see that this last consists simply in making the aerial or antenna the condenser, by the discharge of which the oscillations are established. If the secondary terminals of an induction-coil are connected to two spark balls, one of which is joined to the earth and the other to an insulated aerial wire, we have simply a combination in one, of the oscillatory and radiating circuits. No novelty is introduced by merely joining an additional condenser across the spark gap as some subsequent patentees have done and little utility is obtained thereby.

All the numerous arrangements of transmitters or wave producers for Hertzian wave telegraphy which have yet been devised are only modifications of the above described three methods, and however much patentees have rung the changes upon them or disguised their form for the sake of inducing patent offices to grant a patent, every transmitting arrangement in practical use for wireless telegraphy by electric waves consists simply of an oscillatory circuit in which energy is stored electrostatically and released in the form of electric oscillations, this circuit being generally a nearly closed circuit connected directly or inductively with an open or radiating circuit. The original simple circuit of Marconi in which the energy-storing and radiating circuits were one and the same, being the type from which the other two have been developed.

The appropriate method of expressing the energy-storing capacity of any such arrangement would be to state the energy in joules stored up before each discharge. This may vary from 1 to 100 joules or more.

We have then to consider the important function of the radiating circuit, viz., the aerial or antenna. The object of the whole apparatus being to make waves in the ether, it is not merely important to consider how much energy the system will store up but how much it throws off at each discharge. The original simple nearly vertical wire, devised by Marconi, has in course of time been modified by him into more complicated arrangements. The single wire has been mutliplied into a group of wires arranged parallel in cage fashion, or in fan or inverted umbrella shape. The purpose of this multiplication is to increase the surface so as to obtain more capacity, with respect to the earth, but another reason is to reduce the inductance. On the electronic theory an electrical oscillation established in a wire implies that electrons are rushing backward and forward in it, or rather that there is an atom-to-atom exchange of electrons which is equivalent to such a motion. The electron only radiates when it is being accelerated positively or negatively.[12] Hence, to obtain the greatest radiative effect from an open circuit there must be as little inductance in it as possible, that is, there must be as few obstacles as possible to the rapid reversal of motion of the electrons. This involves giving the largest possible *surface* to the aerial, and hence multiple wire aerials suitably arranged are more effective radiators than sheets of metal. For ship purposes a couple of 7/18 or 7/22 stranded wire cables of bare tinned copper wire are generally used. These are placed about 6 feet apart and are about 180 feet in length. They are upheld by insulators from a special wooden gaff, which is secured to the top of the ship's mast. The capacity of such an aerial is about 0.0005 or 0.0006 of a microfarad, or say 1/2000 of a microfarad. When used as a transmitting aerial it is essential to have very good insulation at the top of the aerial where the potential amplitude may be equivalent to that required to produce a spark 10 or 20 centimetres in length.

On the other hand, when used as a receiving aerial good insulation near the base is essential to prevent a sensible part of the current being shunted round the receiving appliances. In the case of very large aerials, the capacity may run up to 0.1 of a microfarad or more and when used as transmitting aerials with very high potentials, the currents flowing into and out of the base of the aerial may be something enormous. The mean equivalent heating current may even be 40 to 50 amperes, but of course the maximum instantaneous value at the commencement of a train of oscillations may reach hundreds of amperes. The wave radiated from an aerial may of course correspond either to its fundamental electrical oscillator or to any higher odd harmonic which complies with the condition that the summit of the aerial is a potential antinode or loop and the base or earthed end is a node.

The practical problem which presents itself in setting an aerial into operation is, in the first place, the syntonization of the aerial with its associated condenser or energy-storing circuit. This equalization of the time-periods of the two associated circuits is for the most part accomplished by a process of trial and failure in which the personal skill of the operator counts for a good deal. The auto-syntonization of the transmitter circuits may be roughly obtained by placing a hot wire voltmeter across a section of the lower part of the aerial and adjusting the condenser circuit until the maximum reading of the instrument is reached. The guidance so obtained is, however, only approximate, because it is obvious that variation of the constants of the condenser circuit varies the frequency of the sparking and this again affects the mean value of the current into the aerial

(To be concluded next month.)

by C. Arldt. Also, a pamphlet published by the Algemeine Elektricitäts Gesellschaft.

9. See letter in the *Electrician*, Vol. 52, April 15, 1904, p. 1033.

10. See Marconi British Specification No. 7777 of 1900. Also a Lecture before the Society of Arts of London, May 17, 1901. *Journal* Soc. Arts, Vol. 49, p. 506.

11. See British Patent Specification, J. A. Fleming, No. 3481 of 1901. Date of application, February 18, 1901.

12. See J. Larmor, "Æther and Matter," Adams Prize Essay, p. 236.

PERSONAL

C. M. Mitchell has sold his telephone exchange at Haley, Texas.

Daniel Duff has been granted a telephone franchise at Pierce, Nebraska.

J. F. Nordin is seeking a franchise for a telephone line at Gowrie, Iowa.

Carl Anderson will install a local telephone system at Sacred Heart, Minnesota.

J. W. Ward has purchased the local telephone exchange at Sauk Center, Minnesota.

W. B. Bascom has commenced rebuilding the telephone system at Harvey, South Dakota.

V. K. Herlan has been selected as manager for the Woodsfield (Ohio) Telephone Company.

Fred Wakefield has been appointed manager of the telephone system at Lapeer, Michigan.

H. Jaehning is considering building a telephone line in the vicinity of Waseca, Minnesota.

D. G. Cahoon has been granted a franchise for a telephone system in Lander, Wyoming.

R. H. Redfield has resigned as manager of the Smithville (Texas) Telephone Company.

Clarence Hatch has been appointed manager for the telephone company at Algoma, Wisconsin.

George H. Morrison has been appointed manager of the Kissimmee (Fla.) telephone exchange.

W. G. Ownby of Blue Ridge, Georgia, will install a telephone system at Lafollette, Tennessee.

C. V. Amerman contemplates a rural telephone system in the vicinity of Danville, Pennsylvania.

H. C. Budge and others are agitating the subject of a new telephone company at Miami, Florida.

J. L. Burroughs has purchased the Grinnell and Newburg rural telephone lines near Grinnell, Iowa.

A. J. Kennedy has been appointed supervising engineer for the Fulton (N. Y.) Telephone Company.

J. W. Moore & Company have purchased the Independent Telephone Company at Pendletonville, Texas.

F. J. McComb of Lebanon, Missouri, recently purchased the telephone exchange at Humansville, Missouri.

Oliver J. Hawkins has been appointed manager for the Home Telephone Company of Cohoes, New York.

John Woodward of Barbourville, Kentucky, has leased the London (Ky.) telephone exchange for two years.

E. E. Larham is the new manager of the Inter-Ocean Telephone Company's exchange at Penn Yan, New York.

G. M. Coddington, formerly of Holton, Kansas, has purchased the telephone system at Cleveland, Oklahoma.

L. S. Erbes of St. Paul, Minnesota, is negotiating for the purchase of the Oakville, Iowa, telephone exchange.

George W. Anderson has sold the Lawrence County telephone system at Black Rock, Arkansas, to C. A. Bedgood.

J. J. Groesbeck of Waterville, Kansas, has sold two miles of a local telephone line to the Irving Telephone Company.

L. O. Williams has been appointed manager for the Buffum and Kinloch telephone exchange at Fulton, Missouri.

Charles E. Knickerbocker has sold his interest in the Concord, Michigan, telephone system to Frank J. Rhodes.

L. G. Johnson of Fort Wayne, Indiana, treasurer of the Delaware & Madison Counties Telephone Company, died last month.

H. C. Fuhr has been appointed assistant superintendent of the Ohio Valley Telephone Company, at Bellaire, West Virginia.

R. P. Bonathon, who recently purchased the telephone system at Havre, Montana, will build a line from Havre to Chinook.

F. B. McElroy and S. A. Jones have applied to the city of Dallas, Texas, for a franchise to construct a telephone system.

C. D. Burkhiser has been appointed to the management of the telephone business at Hailey, Idaho, to succeed John R. Hart.

A. K. Gray has been appointed manager of the Star Telephone Company of Farmington, Minnesota, to succeed H. K. Brookins.

Frank Brown, who was one of the most prominent Independent telephone men in Iowa and was interested in exchanges at Ottawa, Wichita and Emporia, besides operating a large number of toll lines, died recently.

A. F. Cronquist, J. A. Lang and E. E. Payne have been granted a twenty-year franchise by the city council of Erskine, Minnesota.

C. L. Barnes has resigned as manager of the Williamson County (Texas) Independent Telephone Company and has gone to Waco.

Mr. and Mrs. Richard M. Johnson of St. Louis announce the marriage of their daughter, Annie, to Milton Mill, Monday, December 5.

G. W. Mason of Kanawha, Iowa, has been elected president of the Hancock County Rural Telephone Company to succeed E. C. Abbey.

T. B. Seaton, owner of the Seaton Ferry, is interested in the construction of a telephone line from his ferry to Wilbur, Washington.

J. A. Page has assumed the local management of the Citizens' Telephone Company at Potterville, Michigan, vice John F. Collins, resigned.

Ole Jenson, owner of the Cadott (Wis.) Telephone Company, will extend the system from Stanley to Thorp, and build other rural lines.

Henry Wilson of Wimbledon, North Dakota, has closed a deal whereby he now owns the telephone exchange at New Rockford, same state.

S. D. Ballous has applied for a franchise to construct and maintain a telephone system along the public roads of San Luis Obispo county, California.

J. H. Hays, manager of the Central Telephone Company at Faulkton, South Dakota, contemplates making extensive improvements in the system.

H. B. Huston has secured a franchise for putting in a telephone exchange in Madisonville, Texas, and already has begun construction work on the system.

H. D. Smith has resigned as manager of the People's Telephone Company of Paducah, Kentucky, and will be succeeded by H. E. Murty of Troy, New York.

Charles F. Kline has resigned his position as manager of the Mediapolis (Iowa) Telephone Company and has been succeeded by H. S. Rosmus of Yarmouth.

V. K. Herlan has been appointed manager of the Woodsfield (Ohio) Telephone Company. Mr. Herlan is also manager of the Summerfield Telephone Company.

John Golding, who is also principal stockholder in the Sims Telephone Company, has sold his franchise in Converse, Indiana, to the Amboy Home Telephone Company.

C. E. Monk, manager of the telephone exchange of Fairbury, Illinois, and George Monk of Chicago have purchased the exchange of T. R. Vorhees, the former owner.

S. C. Thayer has asked the Girard, Ohio, council to extend the terms of his telephone franchise until spring, as he does not wish to do the work in winter. His request will be granted.

A. F. Ramsey of Crawfordsville, Indiana, is reported as saying that the Home Telephone Company of that city will put in an automatic switchboard some time during the coming year.

Frank S. Lewis of Allentown, Pennsylvania, had an ordinance introduced in the Coopersburg council for a franchise for a telephone line there, and the same was passed on first reading.

C. L. Howk has resigned the position as manager of the Local Telephone Company of Norwalk, Ohio, and has become manager of the Citizens' Telephone Company of Plattsburgh, New York.

W. W. Main of Elk Point, South Dakota, closed a deal with Michael Ryan whereby he comes into possession of all of Mr. Ryan's interest in the Elk Point telephone plant and franchise.

W. Forman Collins, vice-president and business manager of the Electrician Publishing Company, Chicago, died suddenly on the morning of December 21, the funeral being held from Trinity church in that city December 23. Mr. Collins was highly esteemed by a wide circle of friends and his death is a matter of general regret.

H. M. Eldred, the genial manager of the Standard Telephone Manufacturing Company of Milwaukee, while in Chicago last month on business, made a pleasant call at the office of TELEPHONY. Mr. Eldred reports the business of the Standard company on the increase, and the outlook for 1905 the best in the history of the concern.

I. J. Kusel of the firm of Kusel & Kusel, telephone manufacturers, Chicago, will deliver an address before the South Dakota Independent Telephone Association, at Sioux Falls, January 12, on the subject, "The Relation of Automatic Exchanges to Manual System, and Vice Versa." As Mr. Kusel is very well informed on this subject, having visited almost every automatic exchange thus far installed, and having traveled extensively among the manual systems throughout this country and abroad, unquestionably the subject will be well treated.

Telephone Tales Tersely Told

The Topeka (Kan.) Independent Telephone Company is contemplating extensive improvements.

The Inter-State Telephone Company of Little Falls, New York, announces many additional lines to be constructed in the near future.

The Badger State Telephone Company has purchased the Crosby & Blaisdell Telephone Company at Winslow, Illinois, taking possession December 1.

The business men and farmers around Byron, Oklahoma, have met and organized a mutual telephone company to build an exchange and rural lines.

At a special meeting of the Sheldon Commercial Club at Sibley, Iowa, it was decided to ask the city council for a franchise for an Independent telephone system.

Lawrence county, Pennsylvania, farmers have organized a telephone company which, it is said, is to be the beginning of a rural system covering western Pennsylvania.

The Houston (Texas) Independent Telephone Company found that a necessity existed for an enlargement of its service and spent $10,000 recently in making improvements.

Articles of merger and consolidation have been filed by the Winchester Telephone Company of Virginia and the Cumberland Valley Telephone Company of Baltimore.

S. P. Sherin, president and general manager of the New Telephone Company at Indianapolis, Indiana, has ordered plans for the erection of a handsome new exchange building.

The Rev. R. H. Conwell of Temple church, Philadelphia, is arranging so that a former member of his congregation in Chicago can hear his sermons by telephone as delivered.

The Emmet County Telephone Company, which has been voted a franchise at Estherville, Iowa, will begin work at once on its new system, and expects to have the line in operation by spring.

Supt. J. J. Sullivan has just installed a telephone system at Covington, Louisiana, at a cost of $12,000. The system has a capacity of 400 telephones, a large number of which are on country lines.

The supervisors of Los Angeles county, California, have granted to Louis Blankenhorn a permit for a telephone and telegraph line in Cahuenga Valley, Ballona, Centinela and Santa Monica Road districts.

A report from Chester, Pennsylvania, states that telephones are being installed in all the toll-gates along the Chester pike. The instruments will be open for public use and will be equipped with automatic coin boxes.

The Kinloch Long-Distance Telephone Company recently made connections at Jerseyville, Illinois, with the Illinois Telephone Company's lines, forming through service from St. Louis to all the principal cities in Illinois.

Since the incorporation of the Independent Telephone Company at Council Bluffs, Iowa, a number of companies have signified their intention of making extensions to connect with the new system when it is established.

The toll line of the Home Independent Telephone Company has been completed to Ottawa, Kansas, opening up direct communication with Kansas City and all points in the Kaw Valley. The line will be extended south into the oil fields.

The Tuscarawas County (Pa.) Telephone Company has completed plans for renewals and improvements that will involve the expenditure of over $60,000. The entire plant is to be recabled and a general renovation of the whole system is planned.

C. M. Shattuck of Durand, Michigan, awoke almost suffocated by coal gas escaping. His wife was unconscious and it was with great difficulty that Shattuck crawled to the telephone and called a physician, which act probably saved the lives of both.

The Tri-City Telephone Company (sometimes erroneously called the Twin-City) has been incorporated at Clinton, Iowa, with a capital stock of $600,000 and bonds $400,000. This company operates exchanges in Clinton and Lyons, Iowa; and Fulton Illinois.

A series of improvements which will amount to over $40,000 is being inaugurated by the Kinloch Telephone Company at Alton, Illinois, in the putting of large heavy cables, which will be extended all over Alton, Upper Alton, North Alton and parts of Yager Park.

The Independent telephone companies operating in Nebraska intended to make an effort in the coming legislature to secure the passage of a bill obliging the Bell Telephone Company to exchange toll messages with them, on the theory that telephone companies are common carriers.

The Dosbaugh Telephone Company, with headquarters at Sedan, Kansas, has just changed its lines from ground to metallic circuits. This company has exchanges at Caney, Peru, Elger, Sedan and Cedar Vale, making about 1,000 subscribers, and represents an investment of about $85,000.

The new directory recently issued by the Sioux Falls, (S. D.) Citizens' Telephone Company shows a remarkable increase and growth since it was established. The system is now giving service to over 1,400 local patrons, and the line force is busy all the time with additions and changes.

The Flora (Ind.) Co-operative Telephone Company has been sold to a company composed of ten local men. These same gentlemen a few weeks ago purchased the Miller system at Flora for $11,160. The two systems have been merged and incorporated as the Flora Telephone Company.

With the idea of testing the life of telephone and telegraph poles by proper seasoning, experimental stations will be established by the bureau of forestry of the department of agriculture at Marinette and Ashland, Wisconsin. The department will be aided by the different telephone companies.

Owing to the death of Judge James M. Thomas the Portsmouth (Ohio) Telephone Company has been reorganized by the election of the following officers: President, I. S. Grimes; vice president, Joseph S. McKell, Chillicothe; secretary and treasurer, Dr. W. D. Temper; general manager, E. E. Knox.

A municipal telephone station system will be installed in Hot Springs, Arkansas. The matter has been considered by the mayor and council, and convenient stations for boxes picked out, which will connect headquarters with all parts of the city by telephone. The new equipment will be installed by January 1.

Plans are being prepared for a seven-story building at the northwest corner of Tenth and Locust streets, St. Louis, to be erected by Adolphus Busch for the Kinloch Telephone Company. The structure will be a first-class fireproof building, arranged especially to meet the requirements of the telephone company.

The striking telephone girls formerly employed by the Pacific States Telephone Company at Portland, Oregon, are busy circulating a petition asking that a competitive company be given a franchise. Members of the Operators' Union generally are engaged in the work and claim to be meeting with encouraging success.

The St. Joseph (Mo.) Citizens' Telephone Company is stringing new cables into the suburbs of the city, and will continue to do so until the entire city is covered with large cables. During the next ten or twelve months new cables will be put in sufficient to accommodate from 3,000 to 3,500 telephones, in addition to those now in use.

At a meeting of the Monroe Telephone Company, the Walton Telephone and Telegraph Company, and the Monroe & Compton Telephone and Telegraph Company, at Monroe, Georgia, a consolidation of the companies was effected and beginning January 1 the new company will be known as the Monroe Telephone Company.

A recent meeting of the Business Men's Association was held in Salt Lake City, Utah, to protest against the prevailing rates of the Rocky Mountain Bell Telephone Company. After listening to a statement from the manager of the telephone company it was decided to make a thorough investigation before definite action be taken.

As the result of a conference between the officials of the Citizens' Telephone Company of Sheboygan, Wisconsin, and State Superintendent C. M. Cottrell of the Wisconsin Telephone Company, the latter concern has agreed to leave the field in Sheboygan and Sheboygan Falls, and turn over its local service to the Citizens' company.

The Fulton (N. Y.) Telephone Company has decided to enlarge and improve its system to meet the demands of numerous applicants whom they are unable to accommodate at the present time. The work of improvement will include a new line of cables throughout, new and large switchboards, new telephones and many other minor changes.

The third attempt on the part of the Queen City Telephone Company to secure entrance to Cincinnati was begun recently in the Circuit court. The original case was decided for the Queen City Telephone Company by the late Judge Nippert. This decision

was reversed by Judge Littleford and the case was taken to the Circuit court on appeal.

The Eastern Illinois Independent Telephone Company, which began business at Kankakee, Illinois, June 1 with 500 telephones, now has nearly 1,200. The company has been installing from seventy-five to 125 telephones per month from the start and has not been able to keep up with its orders, being at the present time more than 100 telephones behind its contracts.

Toledo telephone offices will hereafter hold long-distance operators responsible for all toll bills that may be incurred, it is said. The operator must collect in full for each message or the amount of shortage will be taken from her salary. The companies have also made a rule that operators shall not call for individuals, but instead the number of the telephone only.

The Clinton (N. Y.) Home Telephone Company will extend its system. Quite recently an exchange was opened at Westmoreland, and the people at Deansboro are asking for an exchange, promising fifty subscribers for a start. During the past year seventy-five new subscribers have been added to the list in this village and orders for others are being received almost daily.

The Cuyahoga Telephone Company of Cleveland is establishing street telephones in that city for the use of the public. Two have been erected for experimental purposes, the use of which will be free to the public until January 1. After that, except for ambulance, fire or police calls, they will be regular pay-stations. If it is found that these telephones pay others will be established as the need arises.

F. B. McElroy, who for some time has been endeavoring to secure an Independent telephone franchise in Dallas, Texas, has stated that he would contribute the funds necessary for holding a special election to decide whether the voters of that city desire an Independent telephone system. If the voters should decide favorably, there is very little doubt that the council would grant such a franchise, it is declared.

The National Telephone and Electric Company, which absorbed the Farm and City Telephone Company at Clinton, Illinois, is capitalized at $100,000 and has 2,700 miles of wire in six counties—DeWitt, McLean, Piatt, Champaign, Macon and Logan. Negotiations have been pending for months and the aggregate amount of money involved in the transaction is probably the largest of any like deal consummated recently in Illinois.

The Yellowstone Park Telegraph and Telephone Company brought its wires into Bozeman, Montana, recently, and established an office in the Bozeman hotel. The telephone service will include Big Timber, Helena and Butte, and will be extended later. The telephone system will connect with the Postal Telegraph Company at Butte, and a general telegraph business will be conducted. The Bozeman office probably will be opened before the end of the month.

The ringing of a telephone saved $160 and a diamond ring from being taken from the safe in the Hoagland grocery store in Fort Dodge, Iowa. While one stranger engaged the attention of the lone clerk in the front of the store another asked to use the telephone. Just as the cash drawer in the safe had been pried open the telephone rang. Upon the appearance of the clerk to answer it the stranger made a hasty exit. All trace of the sneak thieves was lost.

J. C. Duncan, president and general manager of the People's Telephone Company at Knoxville, Texas, is reported as saying that an automatic system will be installed in that city when the list of subscribers reaches 3,000. The company now has 1,500 telephones in service. There has been a lull in telephone work on account of the inclement weather, but as soon as the weather improves the company will do a large amount of work both inside and outside of the city.

A telephone line forty miles long has been completed from Leslie, South Dakota, on the Cheyenne river, for the accommodation of ranchers on the Cheyenne reservation. Most of the line is simply wire fence which is used on the boundary line of the reservation pastures, and the system is to be extended in the same way. The line now in operation is all on the Indian reservation, but a general system with Leslie as a central point is being planned to cover a large part of that portion of the state.

The Inter-State Telephone Company is constructing a new copper circuit from Sterling to Rock Island, Illinois. It will probably require six weeks to accomplish the work. When this line is completed the Inter-State will have a direct toll line from Sterling to Rock Island. The cost of this improvement will be close to $12,000. The company will also string a new copper circuit from Sterling to Dixon. When this work is completed the Inter-State will have three toll lines running to Dixon from Sterling.

R. W. Kemp, contracting engineer, of Wichita, Kansas, has just completed an exchange for the Farmers' Mutual Telephone Company at South Haven, Kansas, and has secured the contracts to build the mutual lines for the Chickaskia Mutual Telephone Company from Milan to Wellington, via Mayfield, and the Oxford Mutual Telephone Company, from Oxford to Wellington, via Dalton. The lines when complete will connect with the Farmers' Mutual Company at Wellington and make a mutual system of over 2,000 subscribers.

An important change in the organization of the Lee County (Ill.) Telephone Company was recently consummated, whereby all of its property and business has been transferred to the Dixon Home Telephone Company, which was recently incorporated at $125,000, and under which name its business will be conducted in the future. A meeting of the board of directors was held and plans completed for the accomplishment of this purpose. The work of reconstruction has been going on for some time and within a very few weeks the company will have in operation one of the finest telephone systems in the middle west.

Charles E. Summer, manager of the Empire Electric Company, of Toledo, Ohio, has applied to the city council of Spokane, Washington, for a franchise to run an Independent telephone system in Spokane. His company is represented at Los Angeles, San Diego and other California towns. He agrees to expend $300,000 in Spokane in three years and proposes ultimately to operate with the Independent system of Seattle in long-distance business. The Sunset company is making a vigorous fight to prevent the new company from securing a franchise, but it is believed that it will be unsuccessful, as the citizens of Spokane are almost a unit in desiring an Independent company and improved service in that city.

A recent decision by the Pennsylvania Court of Appeals marks what telephone interests say will probably be the passing of the last of the patents which were controlled by the Bell company exclusively, thus giving the Independent companies an equal chance with the Bell in all fields. The case was known as the Caty patent suit, which involved the right to use the "bridge bell" system used on party lines. The suit was decided in favor of the Independents more than one year ago. An appeal was taken by the Bell interests and this was delayed and a second hearing made necessary by the death of one of the judges, the other two failing to agree. The last decision, which was favorable to the Independent companies, was anticipated by them, and they have been using the party line system for some time.

FROM RURAL EXCHANGES.

Now the poles are up, waiting for the telephones to come. For some cause the farmers had to hump their backs and get the poles set themselves. Perhaps they may get a credit mark in the future. —*New Durham Doings in Laporte (Ind.) Herald.*

The Hot Air and Richfield-Plainville telephone lines are now connected and our telephone service in this vicinity improved. Mr. Editor you can "hello" at Uncle Jack as often as you feel disposed to and no charges will be made.—*Richville Ripples in Plainfield (Ill.) Messenger.*

Arrow Rock now has a very successful telephone exchange. It seems all the communities are leading Malta Bend in public improvements. What is wrong? Is our people asleep or in a trance? For de Lord's sake let us wake up and get a move on ourselves.—*Malta Bend (Mo.) Qui Vive.*

Picking up items is a little tedious since the telephone lines have been put up, as the young folks do their private talking over the wire, and do not get to town so often; and as no one has given me a phone yet, I am not able to catch on to all that transpires.—*Brazilton Buzzings in Walnut (Kan.) Advance.*

We wonder why the Fairview Telephone Company don't get its end of the line ready for connection with Elmcreek? Ah! Mr. Pettitt, Mr. Edgerton and Mr. McCartney, we would enjoy very much a little talk over the telephone with the boys at Elmcreek.—*Miller Maxims in Kearney (Neb.) Daily Hub.*

Say, don't you think a telephone would look nice on the wall, it would be useful too, and how nice it would be to talk to one of your neighbors without walking or riding a mile or two to say what you would say while you were getting ready to go, or ask the price of grain or live stock.—*Mayflower Musings in Hastings (Neb.) Tribune.*

It is "hello" to Sunny Dell ranch now as W. J. Jones has finished the telephone line, arranging the telephone and everything was ready for talking about noon to-day. It has been "one long, one short and one long ring," on the telephone from their many friends here in town, sending well wishes and greetings over the line to all the family.—*Garberville "Special" in Eureka (Cal.) Standard.*

The well known superintendent of the Central Union Telephone Company went out riding in the country with his lady friend. He went to Spring Lake. On his way down his hat blew off and fell into a pond of water and he could not recover it. He was almost frantic to think he would have to come home without a hat. He stopped at a farm house, where he bought an old straw hat used in the field. No one knew him on his return to Pekin and the livery man had to look several times to make sure that it was the same man who hired the rig.—*Peoria (Ill.) Star.*

IN THE RURAL LINE DISTRICTS

Hello at Kensal waits for poles.—*St. Paul (Minn.) News.*

The citizens of Sherwood are going to be blessed with a telephone exchange.—*Quincy (Mich.) News.*

James Randolph is doing fine work on the farmers' telephone line.—*Fargo Facts in Falls City (Neb.) Tribune.*

Buckley now has direct telephone connection with Cissna Park. Will Hale wired the last gap last week.—*Buckley (Ill.) Chronicle.*

The Hoagland Telephone Company put in their telephones this week and "Hello" is the password.—*Poe Pointers in Ossian (Ind.) News.*

The rural telephone from Toronto is now finished and everybody is kept busy talking.—*Argo Items in Brookings (S. D.) Individual.*

Robert Barr, the Bell telephone manager, was in our midst one day last week.—*Central Square Chips in Hamilton (Ohio) Republican-News.*

W. G. Lehman is busy putting up telephone poles and telephones. He is a busybody and is making it pay.—*Yates City Letter in Galesburg (Ill.) Mail.*

E. Pluribus Unum suggests a police telephone system to make the police work faithfully. How about that, members of the force? —*Janesville (Wis.) Gazette.*

A telephone line from Sulphur to Oriole is being talked of here. There is nothing like being up to date if the process is a nuisance. —*Sulphur Skits in English (Ind.) News.*

Mr. Johnpeter of Posey was in town Wednesday with his line man, and also placed a telephone in the Model saloon.—*Germantown Glimpses in Carlyle (Ill.) Constitution.*

The Independent Telephone Company has a system of wireless telephony between Lena and McConnell. The wire workers will go over the line in a few days.—*Lena (Ill.) Star.*

The telephones are all in working order in this vicinity and it is to be hoped that the newness has worn off in pity of "Central."—*Oneka Offerings in Stillwater (Minn.) Gazette.*

A Macon county farmer is in sore trouble. He is charged with swearing over a telephone.—*Memphis (Mo.) Reveille.*

The rural telephone has sounded the death knell to the vocation of the yeggmen. With the general introduction of the "ting-a-ling" their occupation is gone.—*Manson (Iowa) Democrat.*

Bids are being received for the position of "hello" girl on the farmers' telephone line. They range from $8 up to $35. Who will get it?—*Willis Whispers in Horton (Kan.) Headlight.*

Some old-timers deplore the day of telephones, because the feat of escaping their wives when they command that the wood box shall be filled and the water pail replenished. One of them, utterly

oblivious to the "eternal fitness of things," calls a telephone a woman's tongue enlongator. That fellow now trembles when he sees two or three of the fair sex consulting together.—*Blairstown Item in Van Horne (Iowa) Record.*

Will De Leno, manager of the Manitowoc Telephone Exchange, gave Chas. Kirst an "Emergency summons" to Manitowoc last Sunday evening. Charley left everything to respond to the summons, thinking some great calamity had happened to the exchange at Manitowoc that needed his expert skill in setting aright. When he got to Manitowoc he found that all that was wanted of him

was to serve as chaperon to the six Manitowoc telephone girls—all very beautiful girls, Charley says—whom Manager De Leno was entertaining at a "Hell-o-Supper," that was good enough to satisfy anybody.—*Stewart (Minn.) Tribune.*

A new telephone wire has been put in on the Kirby road as several more families are to have machines placed in their homes. —*East Burke Etchings in St. Johnsbury (Vt.) Caledonian.*

The members of the new telephone line were entertained with organ, graphaphone and vocal music the first evening their telephones were installed.—*Long Point Pickings in Clinton (Ill.) Public.*

All members of the Waddams township telephone association are requested to be present at the next regular meeting at the Goose Neck school house.—*McConnell Mites in Freeport (Ill.) Journal.*

The Farmers' Telephone Company will soon have its line connected with Hartland. This will be very convenient for a dry town like this.—*Manchester Correspondence in Albert Lea (Minn.) Tribune.*

Our telephone company met Wednesday night and finished their arrangements for the line. It will be pushed right along now and we can soon talk with "you all."—*Battlefield Notes in Pleasanton (Kan.) Observer.*

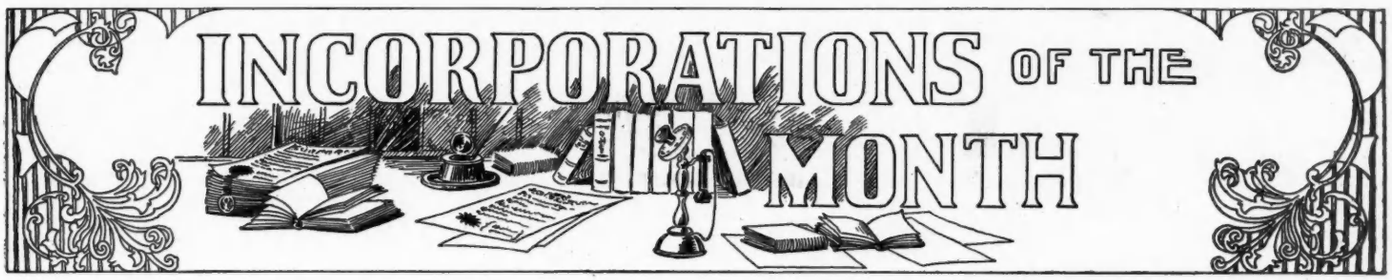
A new telephone has been placed in the M. E. parsonage, the same causing Rev. Brown to smile. No impediment should be placed in the way of a preacher's talking.—*Bradyville Bits in Clarinda (Iowa) Herald.*

Mr. Gazely has extended the telephone line to the valley. We understand he is going to put in a switchboard at Mrs. Fish's, as there are too many telephones on the one line.—*Sherman Scraps in Brookings (S. D.) Register.*

The Shaw Telephone Company expect to extend their line through here soon. Then we can stand in our own home and talk with any one in the state by paying a small switch fee.—*Clear Creek Crumbs in Osseo (Wis.) Record.*

A Marysville farmer chopped down some of the telephone poles of the Wright County Telephone Company and now he has the pleasure of paying a good round price for the same. He don't enjoy the sport.—*Watertown (Minn.) News.*

We have the telephone fever here and if we can secure one more subscriber we can secure a line through this neighborhood, connecting with the Harris system. They have a good line and are extending their lines in every direction from Harris. The Williamsburg line runs to Harris and both lines use the same hello.—*Glenwood Grist in Burlington (Kan.) Jeffersonian.*



ARKANSAS.

OZARK—The Western Telephone Company. Capital stock, $100,000. President, J. F. Maxey; vice-president, Will Hill; secretary. John E. Bryan; treasurer, L. R. A. Wallace.

SILOAM SPRINGS—The Siloam Springs Telephone Company. Capital stock, $50,000. President, R. J. Alfrey; secretary and treasurer, M. T. Stahl; directors, Tom Williams and W. T. Stahl.

BEARDEN—The Bearden Telephone Company of Bearden. Capital stock $2,000, of which $1,000 has been subscribed. President, Wm. M. Gatling; secretary, Jeff Gatling; treasurer, Wm. Gatling, Jr.

CALIFORNIA.

SANTA ANA—The Smeltzer Telephone Company has elected the following officers: President, L. B. Lossing, vice-president, H. J. Phelps; secretary, C. C. Johnson.

LOS ANGELES—The Richardson Construction Company has been organized with a capital stock of $500,000 for the purpose of undertaking telephone construction in various parts of Mexico. The principal organizers are Davis Richardson and L. R. Richardson of this city, who are at present extensively interested in the operation of copper mines in the republic.

CANADA.

RICHIBUCTO—Notice has been given for the incorporation of the Richibucto Rexton Telephone Company. Capital, $20,000, divided into 400 shares of $50 each. Provisional directors, Alex B. Carson, Richard O'Leary, Alex J. Girvan, Alex J. Curran and Wm. D. Carter.

ILLINOIS.

GRAYVILLE—The Westfall Telephone Company. Capital stock, $4,000. Incorporators, W. F. Westfall, Claude O. Ellis and Nathan Marsh.

BELLEVILLE—The Rural Telephone Company. Capital stock, $2,000 Incorporators, Albert Hucke, Lucius D. Turner, George W. Detharding.

ALEXIS—The Farmers' Mutual Telephone Exchange Company. Capital stock, $5,000. Incorporators, Allen Moore, Warren Bruington and R. T. Shaw.

SYCAMORE—The Selective Signal and Telephone Manufacturing Company. Capital stock, $100,000. Incorporators: J. C. Joslyn, E. F. Buell, C. A. Bishop.

CHICAGO—The Western Telegraphone and Telegraplex Company. Capital stock, $60,000. Incorporators, Robert P. Jack, Harman W. Danforth and W. T. Irwin.

ORION—The directors of the Orion Telephone Company have elected the following officers for the ensuing year: President, F. L. Anderson; secretary and treasurer, C. R. Hanna; manager, N. A. Ekstadt.

ST. JOSEPH—The St. Joseph Telephone Company, recently incorporated, has elected the following officers: President, O. C. Boggs; vice-president, T. J. Wardin; treasurer, N. G. Glascarch; manager, J. O. Henerson.

INDIANA.

SALEM—The Blue River Telephone Company. Capital stock, $1,200.

LIBERTY—The Liberty Telephone Company. Capital stock, $20,000.

MADISON—The Standard Bracket and Pin Company. Capital stock, $12,000. Incorporators, A. L. Schmidlap, G. W. Cofield, B. F. Head and others.

LAKETON—The Disko and Laketon Telephone Company. Capital stock, $15,000. Directors F. J. Zimmerman, Edwin L. Harmon, H. C. John.

AMBOY—The Amboy Telephone Company. Capital stock, $20,000. Directors, N. W. King, William Myers, B. F. Miller, Noah Shrock, A. D. Hensler.

INDIAN TERRITORY.

HASKELL—The Haskell Telephone Company. Capital stock, $10,000. Incorporators, J. C. Skully, C. E. Henson and W. J. Criswell of Haskell, Earl G. Hopkins and George S. Whidden of Boynton, I. T.

IOWA.

ST. MARYS—The Clanton Valley Telephone Company. President, O. Springer; secretary, T. G. Sever.

KANSAS.

WEBER—The Weber Telephone Company. Capital stock, $5,000.

KIRWIN—The Mutual Telephone Company. Capital stock, $1,500.

BENTLEY—The People's Telephone Company. Capital stock, $1,500.

BEVERLY—The Beverly Telephone Company. Capital stock, $3,000.

OXFORD—The Oxford Mutual Telephone Company. Capital stock, $3,000.

LEWIS—The Edwards County Telephone Company. Capital stock, $5,000.

PARALLEL—The Riley County Farmers' Telephone Company. Capital stock, $2,600.

WINDOM—The Windom Rural Telephone Company has been organized at this place with the following officers: President, B. F. Bengston; vice-president, John Zimmerman; secretary, A. E. Du-

KENTUCKY.

VICKERYVILLE—Farmers' Exchange Telephone Company. Capital stock, $2,000.

VINNIE—The Vinnie Telephone Company. Capital stock, $1,000. Incorporators, John Hill, B. H. McGahan, G. M. McKinley.

JACKSON—The Henrietta Central Telephone Company. Capital stock, $550. Directors: T. J. Spears, Jerry Turner, Allie White.

LOUISVILLE—The Kenyon Construction Company, Urban Building, has been incorporated to build and operate telephone exchanges in Kentucky and adjoining states.

MICHIGAN.

WEBBERVILLE—The People's Telephone Company. Capital stock, $6,000.

UNADILLA—The Unadilla Telephone Company. Capital stock, $9,975.

MINNESOTA.

WOOD LAKE—The Wood Lake Rural Telephone Company. Capital stock, $30,000. Promoters, G. A. Boettcher, J. E. Griffith, A. H. Lowe, W. C. Hauck, G. L. Neumann.

RED WING—The Red Wing Telephone Company, to be incorporated with a capital stock of $150,000, has elected the following officers: President, A. P. Pierce; vice-president, C. A. Rasmussen; secretary and treasurer, D. M. Neill; directors, C. A. Betcher, E. H. Moulton, H. E. Kenson, W. C. Krise, R. K. Grondahl, A. G. Scherf.

NEBRASKA.

PALMYRA—The Palmyra Telephone Company. Capital stock, $4,000. Incorporators, A. R. Maiben, W. H. Exley, T. L. Stewart, O. M. Merwin, L. E. Jones.

JANSEN—The Jansen Telephone Company. Capital stock, $10,000. Incorporators, J. E. Grebe, John Nider, John Bevans, William Gerner, Henry Siebe, Henry Fitte, John A. Friesen, B. F. Knapp, Peter J. Thiesen, D. D. Thiesen, J. O. Friesen, Louis Glebe, D. A. Friesen, Jacob Bartel.

NEW JERSEY.

JERSEY CITY—The Selective Telephone Company, registered office, 76 Montgomery street. Capital stock, $200,000. Incorporators, Leroy S. Lewis, James R. Carroll, W. S. Davis and John J. Mara.

NEW YORK.

ANDOVER—Th Pony Telephone Company. Capital stock, $200. President, O. Smith; vice-president, J. W. Jenkins; secretary, William N. Pingrey; treasurer, Elmer Kaple, all of Andover.

JAMAICA—The Long Island Central Telephone and Telegraph Company. Capital stock, $5,000. Directors, E. H. Snedeker of

Jamaica, C. A. Mathews of Brooklyn, C. W. Hewlett of Rockville Center and others.

ALBANY—The Inter-Borough Telegraph and Telephone Company. Capital stock, $100,000. Directors, Howard K. Wood, Horace S. Gould, Ortho S. Lee, Jr., Charles A. McCredy of New York and Robert G. Martin of Brooklyn.

LEONARDSVILLE—The Leonardsville Telephone Company. Capital stock, $1,000. Directors, Eli S. Brand, Irving A. Crandall, Almeron M. Coon, M. Elmer Ellsworth, A. P. Brown, Laverne A. Baldwin and Isaac T. Webb, all of Leonardsville.

CHURCHVILLE—The Churchville Telephone Company has been organized. Capital stock, $5,000. Directors, William Ormrode, Truman Perry, E. A. Brower, M. J. Bruton, James Brady, Frank W. Potter, C. H. Brescoe, C. H. Colburn, E. J. Ames, Joel J. Snow. Temporary secretary, P. G. Stewart.

STITTVILLE—The Stittville & Camroden Rural Telephone Company has been organized with the following officers: President, C. H. Evans; vice-president, Robert Charles; secretary, O. E. Jones; treasurer, John Evans; general manager, Ellis D. Jones; trustees, Hugh W. Roberts, J. B. Jones, G. W. Jones.

NORTH DAKOTA.

LITCHVILLE—The Litchville Rural Telephone Company has been organized with the following officers: President, O. R. Jones; vice-president, J. H. P. Applequist; secretary, W. A. Wells.

OHIO.

RINARD'S MILLS—The Pryor-Bode Telephone Company. Capital stock, $5,000. Incorporators, J. H. Pryor, M. Beber, G. E. Bode, J. A. Bode, J. F. English.

SUGAR GROVE—The Sugar Grove Telephone Company. Capital stock, $5,000. Incorporators, C. A. Carr, H. M. Anderson, T. R. Mason, J. C. Dallon, W. F. O'Garra.

STAFFORD—The Stafford and Marietta Telephone Company. Capital stock, $10,000. Incorporators, George W. Robinson, H. E. Robinson, A. H. Hughes, F. W. Murrey and Ernest H. Robinson.

OKLAHOMA.

WAKITA—The Grand Valley Co-operative Telephone Company. Capital stock, $2,000. Incorporators, P. R. Smith, William Bair, L. D. Jones.

HENNESSEY—The Center Townsite Rural Telephone Company. Capital stock, $1,000. Incorporators, William Beaman, Ben Thorue, H. Hemphill and R. Renolds of Hennessey and Frank Hassler of Dover.

SOUTH CAROLINA.

GEORGETOWN—The Georgetown & Camfield Telephone Company. Capital stock, $500.

SOUTH DAKOTA.

MARION—The Marion Telephone Company. Capital stock, $10,000. President, Jacob Hieb; vice-president, Fred Hausaner; secretary and treasurer, Dr. A. E. Hofer.

PIERRE—South Dakota Telephone Company. Capital stock, $100,000. Incorporators, A. Ewart, E. P. Farr, W. S. Rowe of Pierre and G. E. Sumner and C. L. Millette of Fort Pierre.

TENNESSEE.

CLIFTON—The Consolidated Telephone Company. Capital stock $50,000. Incorporators, H. B. Stubblefield, of Nashville; W. N. Sloan, of Linden; J. K. and J. F. Barlow, of Savanna, and T. S. Hughes, of Clifton.

TEXAS.

CLARKSVILLE—The Home Telephone Company. Capital stock, $2,500 Incorporators: John B. King, N. B. Boak, and Hiram Glass.

VERMONT.

RUTLAND—House bill 214 has been passed incorporating the Rutland County Telephone & Telegraph Company. Capital stock, $10,000. Stockholders, A. W. Foote and W. R. Foote of Cornwall; D. S. Carpenter, W. E. Grover and W. H. Wilbur of Middletown Springs, and W. F. Otis of Danby.

WASHINGTON.

WALLA WALLA—The State Line Telephone Company. Capital stock, $500. President, G. W. C. Reynolds; vice-president, William Reser; secretary, C. C Maiden; treasurer, P. O. Calvin; general manager, N. E. McCormack.

WEST VIRGINIA.

EGLON—The Eglon Mutual Telephone Company. Capital stock, $5,000. Incorporators, Adolphus R. Fike, Charles Shank, Lloyd Dawson, J. A. King and others.

NEEDMORE—The Hardy Mutual Telephone Company. Capital stock, $5,000. Incorporators, John N. Park, A. D. Walker, R. J. Wilkins and J. W. F. Combs of Needmore and B. E. Brill of Fabius.

PARKERSBURG—The Mountain State Telephone Company has been granted a charter by the secretary of state. Capital stock, $10,000. Incorporators, E. S. Moore, R. S. Moore, E. Browne, S. P. Moore and P. M. McDonough, Jr.

WISCONSIN.

WHITE OAK—The White Oak Telephone Company. Capital stock, $2,500. Incorporators, H. A. Beckwith, Joseph Edge and Mrs. S. I. Couthard.

KILBOURN—The Farmers' Inter-County Mutual Telephone Company. Capital stock, $5,000. Incorporators, D. A. Lanett, H. B. Metcalf, Charles W. Neff, Benjamin Olson.

MILWAUKEE—The Independent Consolidated Telephone Company. Capital stock, $500,000. Incorporators, A. L. Hutchinson, Edward I. Fairchild and Harry S. Hadfield.

ANNUAL MEETINGS.

COLORADO.

ELBERT—The Elbert Mutual Telephone Company. President, C. A. Whittier; vice-president, R. Larson; treasurer, H. D. Duvall; secretary, Mrs. M. E. Merriam; manager, W. S. Epler.

FLORIDA.

MIAMI—The Miami Telephone Company has been organized and the stockholders have elected the following officers: President, Glenn C. Frissell; secretary and treasurer, Harry C. McCown; treasurer, B. L. Sands; directors, Glenn C. Frissell, Edward C. Romfh, A. P. Anthony, Harry C. McCown, Glenn C. Strohm, James T. Sanders and James R. Anthony, Jr.

ILLINOIS.

BLOOMINGTON—The McLean County Telephone Company at its annual meeting elected the following officers for the coming year: F. V. Hamilton; vice-president, William H. Johnson; secretary, Henry Thobro; treasurer, George Burr; general manager, E. C. Martens.

MCCONNELL—The Wadams Township Telephone Association has elected the following officers: President, H. E. Confer; vice-president, Harry L. Fair; secretary, Chas. Confer; treasurer, Geo. R. Winters; board of managers, Geo. Holmes, H. D. Price, Edward VanSickle, Henry Boeke, Harry L. Fair.

LEAF RIVER—The stockholders of the Leaf River & Egan Mutual Telephone Company recently elected the following officers for the coming year: President, Dr. Kretsinger; vice-president, Dr. Mitchell; secretary, David Kretsinger; treasurer, Charles Schelling; directors, W. W. Jones, David Highbarger, C. T. Myers.

INDIANA.

FT. WAYNE—At the annual meeting of the stockholders of the Home Telephone Company the following officers and directors were elected for the ensuing year: President, Charles S. Bash; vice-president, John B. Reuss; secretary and manager, William L. Moellering; treasurer, Max B. Fisher; Charles S. Bash, J. B. Reuss, W. L. Moellering, M. B. Fisher, Isador Lehman, P. W. Smith, G. Max Hofman, W. A. Bohn, George L. Fox.

ELKHART—Articles of incorporation of the Automatic Switchboard & Telephone Manufacturing Company have been filed with County Recorder Vernon. The company is to buy and sell automatic switchboards, telephones and other electric devices. The capital stock is $10,000, divided into shares of $50 each. The life of the corporation is fifty years. The first five directors are Isadore J. Kusel, Harry J. Kusel, Harry C. Randall, Edgar L. Kerstetter and George W. Brown. The principal offices will be in Elkhart.

KANSAS.

PLEASANTON—The Battlefield Telephone Company recently held a meeting at this place and elected the following officers: President, A. R. Barker; vice-president, O. M. Gray; secretary, C. E. Roberts; treasurer, T. C. DePew.

MICHIGAN.

GRAND RAPIDS—The Citizens' Telephone Company has elected the following officers: President, E. B. Fisher; vice-president, L. McCoy; secretary and general manager, C. E. Tarte; treasurer, L. W Robinson.

MINNESOTA.

MOUNTAIN LAKE—The North Star Telephone Company has elected the following directors for the ensuing year: S. Balzer, Frank Balzer, J. H. Dickman, C. C. Quiring, J. D. Schroeder.